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# **Providing a legal framework for sustainable space mining activities**

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## Abstract

This thesis aims at shedding light into the arising issue of regulating the commercial utilization of space resources as this new activity is about to become a reality. The difficulty of regulating space mining activities comes first from the uncertainty of whether said activities comply with the current provisions of international space law. Some States have already taken the absence of express prohibition as a sign that the utilization of space resources is permissible and both the United States and Luxembourg recently adopted national legislations expressly allowing it. This triggered a response by the international community mostly underlining that such unilateral initiatives did not represent a fully acceptable solution and that a collective approach should be preferred as it was for the High Seas and the Deep Seabed. However an in-depth study of both regimes shows that they are not easily transferable in the situation of outer space. Nonetheless, the future legal framework for space mining will need to imperatively balance the economic development foreseen with the preservation of outer space's environment.

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## List of abbreviations

Bogotá Declaration:	Declaration of the First Meeting of Equatorial Countries
COFUR:	Cost of filing a user request
COSPAR	Committee on Space Research
CSLCA:	Commercial Space Launch Competitiveness Act of 2015
FAA:	Federal Aviation Administration
IISL:	International Institute of Space Law
ISA:	International Seabed Authority
Kyoto Protocol:	Kyoto Protocol to the United Nations Framework Convention on Climate Change
Moon Agreement:	Agreement Governing the Activities of States on the Moon and Other Celestial Bodies
NASA:	National Aeronautics and Space Administration
Outer Space Treaty:	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies
Remote Sensing Principles:	Principles relating to remote sensing of the Earth from space
Space Benefit Declaration:	Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries
Title IV:	Space Resource Exploration and Utilization Act of 2015
UN:	United Nations
UN COPUOS:	United Nations Committee on the Peaceful Uses of Outer Space
UNCLOS:	United Nations Convention on the Law of the Sea
UNGA:	United Nations General Assembly
UNOOSA:	United Nations Office for Outer Space Affairs
VCLT:	Vienna Convention on the Law of Treaties

## Introduction

With the remarkable development of space technologies, space mining—also labelled “space resource utilization”—is about to become a reality that must be acknowledged into the law. It is all the more urgent since the current debate at the United Nations (hereinafter UN), as well as the divergent opinions expressed by legal experts in different forums, show that the current international legal framework is insufficient to regulate this emerging industry.

At stake, from a legal perspective, are first and foremost the challenges linked to the *res communis* nature of outer space as it is enshrined in the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (hereinafter Outer Space Treaty).<sup>1</sup> Under the *res communis* regime, outer space is open to all countries for access and use on the basis of equality. Consequently, States are free to conduct activities in outer space, including the Moon and other celestial bodies, without having to ask prior permission to other governments.<sup>2</sup> One limit however is the so called ‘non-appropriation principle’ which derives from

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<sup>1</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, entered into force Oct. 10, 1967, 18 U.N.T.S. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

<sup>2</sup> Stephan Hobe, *Article I*, I in COLOGNE COMMENTARY ON SPACE LAW 34 (Stephan Hobe, Bernhard Schmidt-Tedd & Kai-Uwe Schrogl eds. 2009) [hereinafter S. Hobe (2009)].

outer space belonging to the international community: one cannot simply claim exclusive ownership rights over outer space or part of it.<sup>3</sup>

But for the first time since the beginning of the Space Age, space faring-nations and private entities are actively seeking to venture into outer space for its natural resources. The Moon and other celestial bodies, such as Mars and asteroids, contain an abundant amount of resources that are scarce or non-existent on Earth, such as the isotope Helium-3 or useful metals like nickel and platinum.<sup>4</sup> Recent studies estimate that the “value of each asteroid could be somewhere in the trillions [of dollars] or higher”.<sup>5</sup> It is thus with no surprise that we witness the enticement of the private sector for these profitable future prospects; even more so now that the technology to reach and mine outer space is about to become available.<sup>6</sup>

This thesis is narrowly tied to emerging issues linked with these new possibilities and the resulting legal needs they entail as shown by recent international events. Already in 2012, the newly created American company Planetary Resources Inc. was announcing

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<sup>3</sup> Outer Space Treaty, Article II.

<sup>4</sup> Sarah Coffey, *Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space*, 41 CASE WESTERN RESERVE JOURNAL OF INTERNATIONAL LAW 119, 119 (2009) [hereinafter S. Coffey (2009)]; Kevin MacWhorter, *Sustainable Mining: Incentivizing Asteroid Mining in the Name of Environmentalism*, 40 WILLIAM & MARY ENVIRONMENTAL LAW AND POLICY REVIEW 645, 652 (2016) [hereinafter K. MacWhorter (2016)]; Market For Metals, PLANETARY RESOURCES, <http://www.planetaryresources.com/asteroids/market-for-metals/>.

<sup>5</sup> K. MacWhorter (2016) *op. cit.* n. 4.

<sup>6</sup> John Brophy et al., *Asteroid Retrieval Feasibility Study* 8 (2012), [http://kiss.caltech.edu/study/asteroid/asteroid\\_final\\_report.pdf](http://kiss.caltech.edu/study/asteroid/asteroid_final_report.pdf); Mike Wall, *ASTEROID MINING MAY BE A REALITY BY 2025* SPACE.COM (2015)[hereinafter Mike Wall] , <https://www.space.com/30213-asteroid-mining-planetary-resources-2025.html>.



its plans to mine asteroids;<sup>7</sup> followed a year later by Deep Space Industries. Since then, numerous start-ups all over the world have decided to follow the example and invest themselves in planning the mining of the Moon or asteroids. Such is the case of the Japanese start-up ispace Inc. or the Germano-Luxembourgish Blue Horizon.

As the development of the space mining industry progresses, the need for a legal framework regulating space resource utilization increases. The ambiguity left by the Outer Space Treaty regarding the permissibility of such activities has already led two countries—the United States and Luxembourg—to adopt their own national legal framework in order to offer investors the legal certainty they require to further develop their activity, and that current international law might not fully secure.<sup>8</sup>

The choice of the United States and Luxembourg to favor a national framework, rather than wait for the establishment of an international regime, was criticized by the international community; most notably during this year's session of the Legal Subcommittee of the UN Committee on the Peaceful Uses of Outer Space (hereinafter UN COPUOS).<sup>9</sup> Nonetheless, even if the reaction is mostly negative, it is the adoption by the United States in 2015 of such a national framework that sparked in the international community the desire to officially discuss the question during the sixtieth

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<sup>7</sup> Asteroid mining plans revealed by Planetary Resources, Inc., PLANETARY RESOURCES (2012) <http://www.planetaryresources.com/2012/04/asteroid-mining-plans-revealed-by-planetary-resources-inc/>.

<sup>8</sup> See Commercial Space Launch Competitiveness Act, 51 USC, §51301(25 November 2015) (US) [hereinafter Title IV of the CSLCA]; Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace, Mémorial A n°674 (20 Juillet 2017) (Lux.) [hereinafter Loi luxembourgeoise sur l'exploration et l'utilisation des ressources de l'espace ].

<sup>9</sup> Report of the Legal Subcommittee on its fifty-sixth session, held in Vienna from 27 March to 7 April 2017, COPUOS, 60th Sess., at 30-33, U.N. Doc A/AC.105/1122 (2017) [hereinafter UN COPUOS (2017)].

COPUOS' meeting of the Legal Subcommittee.<sup>10</sup> It is only the beginning of a long process and it will take some years before a robust regime for space mining is adopted at the international level.

This thesis will thus analyze the various legal challenges presented by the development of a space mining industry and consider future perspectives for the establishment of an international regime for sustainable space mining activities. Consequently, Section 1 of this thesis will discuss the ambiguity of international space law with regards to the lawfulness of space mining activities. Section 2 will focus on the attempt of the United States and Luxembourg to regulate, within their jurisdiction, space resource utilization. Finally, Section 3 will consider existing international regimes governing the exploitation of natural resources located in other *res communis* in order to propose a legal model for space mining activities, respectful of the outer space's environment.

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<sup>10</sup> Report of the Legal Subcommittee on its fifty-fifth session, held in Vienna from 4 to 15 April 2016; COPUOS, 59<sup>th</sup> Sess., at 12-14, 38, U.N Doc A/AC.105/1113 (2016) [hereinafter UN COPUOS (2016)].

## **Section 1. Compliance of space mining activities with international space law**

To date, international space law essentially consists of five international treaties,<sup>11</sup> namely

- the 1967 Outer Space Treaty, which provides guidelines for activities conducted in space;
- the 1968 Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched Into Outer Space, which defines the rights and obligations of States regarding the rescue of persons in outer space;
- the 1973 Convention on International Liability for Damage Caused by Space Objects, which further develops the rules of liability set in the Outer Space Treaty,
- the 1976 Convention on Registration of Objects Launched into Outer Space, which imposes upon States a duty to inform the United Nations about launched objects;
- and last the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (hereinafter Moon Agreement), which was only ratified by seventeen States.

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<sup>11</sup> Outer Space Treaty, *op. cit.* n. 1; Convention on Registration of Objects Launched into Outer Space, entered into force Sept. 15, 1976, 28 U.N.T.S.. 695, 1023 U.N.T.S. 15; Convention on International Liability for Damage Caused by Space Objects, entered into force Oct. 9, 1973, 24 U.N.T.S.. 2389, 961 U.N.T.S. 187; Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched Into Outer Space, entered into force Dec. 3, 1968, 19 U.N.T.S.. 7570, 672 U.N.T.S. 119; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, entered into force July 11, 1984, 1363 U.N.T.S. 3 [hereinafter Moon Agreement].

In addition, this international framework is complemented by non-binding resolutions of the United Nations' General Assembly (hereinafter UNGA), by several bilateral or regional treaties, State practices and norms of customary international law.<sup>12</sup>

When it became apparent that space resource utilization is no longer a distant dream but a reality that is fast approaching, the first reaction was to question whether it complies with the core principles set in the Outer Space Treaty, which are now customary international law.<sup>13</sup>

The question of the conformity of resource mining with international space law is thus first and foremost one of compliance with the Outer Space Treaty. This is easily explained by the general character of the Treaty, the purpose of which was to create basic guidelines to encompass all activities carried out in space.<sup>14</sup>

But this broad scope turns the question of the applicability of the Outer Space Treaty to space mining activities into a many-heads monster. Does resource mining constitute an appropriation under Article II? Does it require exclusive access which would be against the principle of free access set in Article I? Is it possible to show 'due regard' to other States' interests as per Article IX, when depleting outer space of its natural resources?

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<sup>12</sup> The Development of Space Law: Framework, Objectives and Orientations—Speech at United Nations, MA Xinmin, p. 1.

<sup>13</sup> This is undoubtedly the case for the principles of international cooperation, free use and non-appropriation of outer space. See Vladlen Stepanovich Vereshchetin & G. M. Danilenko, *Custom as a source of international law of outer space*, 131 *Journal of space law*, 31 (1985) [hereinafter V. S. Vereshchetin and G. M. Danilenko]; UN GA Res. 1962 (XVIII), UN GAOR, 18th Sess., UN Doc. A/RES/18/1962 (1963) [hereinafter 1963 Legal Principles Declaration]; Ricky J Lee, Article II of the Outer Space Treaty Prohibition of State Sovereignty, Private Property Rights, or Both, 11 *Australian international law journal* 128–142 (2004) [hereinafter R. Lee (2004)].

<sup>14</sup> P.G Dembling & D.M Arons, *The Evolution of the Outer Space Treaty*, 33 *JOURNAL OF AIR LAW AND COMMERCE* 427–432 (1967).

Many and more of these questions have been and continue to be addressed by legal experts.<sup>15</sup>

However, there is a particularly striking homogeneity among authors and national representatives when they deal with the compliance of space mining activities with Articles I and II of the Outer Space Treaty as regards to the issues raised.<sup>16</sup> The question always comes down to three main issues that will be addressed in this part: is *commercial* use of outer space within the scope of Article I paragraph 2 of the Outer Space Treaty? (A) How will the space benefits stemming from this commercial venture be shared with all countries? (B) And finally, is the appropriation of outer space's natural resources contrary to the principle of non-appropriation set in Article II of the Treaty? (C)

### **A. Lawfulness of the commercial utilization of outer space and its resources**

#### *1. Ambiguity of the Outer Space Treaty*

The phrasing of Article I paragraph 3 of the Outer Space Treaty leaves no doubt regarding the lawfulness of scientific use of outer space since it provides for the freedom to conduct scientific investigation. What is less clear however is whether other

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<sup>15</sup> See for instance on these questions Fabio Tronchetti, *The Space Resource Exploration and Utilization Act: A move forward or a step back?*, 34 JSPA SPACE POLICY 8 (2015) [hereinafter F. Tronchetti (2015)]; RICKY LEE, LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE; 153–202 (2014).

<sup>16</sup> *Ibid* ; UN COPUOS (2017), *op. cit.* n. 9; IISL Directorate of Studies, Background Paper: Does International Space Law Either Permit Or Prohibit The Taking Of Resources In Outer Space And On Celestial Bodies, And How Is This Relevant For National Actors? What Is The Context, And What Are The Contours And Limits Of This Permission Or Prohibition? (2016) [hereinafter IISL DoS Study on Space Resource Mining].

uses of outer space are allowed as well. This is the first important point pertaining to space mining.

As noted before, asteroids and the Moon contain exceptionally valuable minerals that are now scarce or simply non-existent on Earth such as Helium-3.<sup>17</sup> Hence, being allowed to mine and sell these resources would open the door to a potentially high profit industry. But this new industry would be far from falling under the scope of “scientific investigation”. While it is true that the recovery of resources will involve scientific research such as mapping the Moon for water for instance,<sup>18</sup> the primary goal of space mining will be profit.<sup>19</sup> Therefore, commercial use of outer space is inherent to space mining.

Such a prevalence of commercial interests does not necessarily contradict the explicit permission under Article I paragraph 3 of the Outer Space Treaty to conduct scientific activities. This permission does not preclude other uses including the commercial use of outer space.<sup>20</sup> The purpose of Paragraph 3 is not even to allow scientific activities *per se*: there is a general consensus that such activity is already included in paragraph 2 which declares that States are free to use and explore outer space.<sup>21</sup> Rather, Paragraph 3 aims to stress the importance of cooperation between States in leading scientific investigation in outer space.<sup>22</sup> There are thus three basic activities in outer space

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<sup>17</sup>*Supra* p. 2.

<sup>18</sup> ISPACE, EXPAND OUR PLANET. EXPAND OUR FUTURE., <https://www.youtube.com/watch?v=5cMEJTnPq-I>.

<sup>19</sup>K. MacWhorter, 2016, *op. cit.* n. 4.

<sup>20</sup>S. Hobe (2009), *op. cit.* n. 2, p. 35.

<sup>21</sup>*Idem*, p. 36

<sup>22</sup>*Ibid.*

allowed under the Outer Space Treaty: scientific investigation, exploration, and use of outer space.<sup>23</sup>

The meanings of “exploration” and “scientific investigation” are straightforward; they involve scientific activities.<sup>24</sup> The scope of activities allowed under the principle of “free use of outer space” however is not. Commercial use of outer space, while not explicitly included in the Treaty contrary to scientific investigation, is also not explicitly prohibited.

Furthermore, a reading of the Outer Space Treaty shows that specific uses of outer space are only prohibited when explicitly excluded in other provisions of the Treaty.<sup>25</sup> Such is the case for instance of Article IV which provides that “States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction”. So, if commercial use is not categorically forbidden nor categorically authorized, what is it?

This ambiguity had not been missed during the discussions leading to the Outer Space Treaty. The question of the meaning of the term “use” in Article I of the Treaty was raised during the drafting by the French delegate who asked if the “term use in the Outer Space Treaty impl[ies] use for exploration purposes such as the launching of satellites” or if “it mean[t] use in the sense of exploitation”, having in mind the utilization of the

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<sup>23</sup> *Idem*, p. 41.

<sup>24</sup> *Idem*, pp. 34-36.

<sup>25</sup> *Idem*, p. 35; Edwin W. III Paxson, *Sharing the Benefits of Outer Space Exploration: Space Law and Economic Development*, 14 MICH. J. INT’L L. 493 (1992) [hereinafter E. W. Paxson (1992)].

Moon for the extraction of minerals.<sup>26</sup> In his answer, the Soviet delegate explained that “a treaty could deal only with the problem arising at the current stage of human evolution”.<sup>27</sup> Due to the constant and rapid evolution of technologies for space activities, it is understandable that the drafters chose not to give a precise explanation of the scope of “use” in Article I by enumerating permissible uses of outer space. Otherwise, the Outer Space Treaty would have been fast outdated.<sup>28</sup>

As a result, the uncertainty regarding the permissibility of using outer space for its resources remains. Some countries say that space resource utilization is a “use within the meaning of and permitted under Article I”<sup>29</sup> while others strongly believe it goes “beyond what was generally understood as exploration and utilization”<sup>30</sup> of outer space. Consequently, if any solution is to be found, one must interpret Article I of the Outer Space Treaty to determine whether the commercial use of outer space is allowed.

## *2. Interpreting Article I paragraph 3*

Since the Outer Space Treaty is an international agreement, it must be interpreted according to the rules enshrined in Articles 31 to 33 of the Vienna Convention on the Law of Treaties (hereinafter VCLT).<sup>31</sup> Following Article 31, a treaty must first be interpreted in accordance with the “meaning to be given to the terms of the treaty in

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<sup>26</sup>Summary Record of the Committee on the Peaceful Uses of Outer Space, UN GAOR, 63rd Sess., at 8, UN Doc. A/AC.105/C.2/SR.63 (1966).

<sup>27</sup> *Idem*, pp. 10-11.

<sup>28</sup> IISL DoS Study on Space Resource Mining, *op. cit.* n. 16, p. 30.

<sup>29</sup> UN COPUOS (2017) *op. cit.* n. 9, paragraph 246.

<sup>30</sup> *Idem*, paragraph 247.

<sup>31</sup> Vienna Convention on the Law of Treaties, entered into force Jan. 27, Article 1, 1980, 1155 U.N.T.S. 331 [hereinafter VCLT].



their context and in the light of its object and purpose”. The interpretation of the word “use” must thus be consistent with the other provisions of the Outer Space Treaty.<sup>32</sup>

Many authors have tried to determine the meaning of the word “use” as laid down in Article I, without reaching a consensus.<sup>33</sup> Gorove points out that “exploration” and “use” cannot have the same meaning since it would be redundant in the context of Article I.<sup>34</sup> According to Hobe, the term “use” entails both economic and non-economic activities and includes activities the goal of which is to make economic profit.<sup>35</sup> Some also believe that “use” is inclusive of exploitation.<sup>36</sup> In that case, using resources and consuming them like the space mining industry intends to do, would be included in the freedom of use of outer space.

But interpretation also requires taking into consideration the context of the treaty.<sup>37</sup> The interpretation must thus be consistent with other provision of the Outer Space Treaty.<sup>38</sup> Article VI of the Treaty allows, for instance, non-governmental entities such as companies to carry out activities in outer space as long as they are authorized and

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<sup>32</sup> IISL DoS Study on Space Resource Mining, *op. cit.* n. 16, p. 41.

<sup>33</sup> *Idem*, p. 31.

<sup>34</sup> Stephen Gorove, *Freedom of exploration and use in the outer space treaty: a textual analysis and interpretation*, I DENVER JOURNAL OF INTERNATIONAL LAW AND POLICY 98 (1971).

<sup>35</sup> S. Hobe (2009) *op. cit.* n. 2, p. 35.

<sup>36</sup> Stephan Hobe, *Adequacy of the Current legal and Regulatory Framework Relating to the Extraction and Appropriation of Natural Resources in Outer Space*, 32 ANNALS OF AIR AND SPACE LAW ANNALS OF AIR AND SPACE LAW 116–120 (2007); IISL DoS Study on Space Resource Mining, *op. cit.* n. 16, p. 31; also see GA Res. 1348, 13th Sess., UN G.A., UN Doc. A/Res/1348 (XIII) (1958) establishing the *ad hoc* COPUOS and refers to the “exploration and exploitation” of outer space.

<sup>37</sup> VCLT, Article 31.

<sup>38</sup> IISL DoS Study on Space Resource Mining, *op. cit.* n. 16, p. 28.

continuously supervised by their State. By allowing private companies in space, the Outer Space Treaty opened the door to commercial use of outer space.<sup>39</sup>

This interpretation of the term “use” in Article I is further confirmed by subsequent State practice which “constitutes objective evidence of the understanding of the parties as to the meaning of the treaty”<sup>40</sup>. A study of activities taking place in outer space shows that outer space is already being used for commercial purposes. Indeed, satellites placed in outer space are not all for scientific research.<sup>41</sup> They are used every day for commercial purposes. Internet, mobile phones, television, navigation systems... They all rely on satellites and service providers make benefits out of it.<sup>42</sup> Consequently, the commercial use of outer space *per se* is allowed under the Outer Space Treaty.

If we were to limit ourselves to this conclusion, the real question would not be it seems, about the commercial use of outer space, but rather about the reason why space mining still does raise the issue. The explanation of such a discrepancy in the concerns, whether we deal with satellites routinely performing commercial activity and space mining, could be that we are moving from a service industry to a primary and secondary industry. Currently, outer space is used to provide services. Soon, it will be possible to exploit its mineral resources. Therefore, the issue is not that space mining is a

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<sup>39</sup> Mariam Yuzbashyan, *Interaction between Diverse Sources of Law Applicable to Legal Challenges Caused by Commercial Space Activities*, 55 INTERNATIONAL INSTITUTE OF SPACE LAW 2 (2012).

<sup>40</sup> See International Law Commission, *Draft Articles on the Law of Treaties with commentaries*, II YEARBOOK OF THE INTERNATIONAL LAW COMMISSION 221 (1966) about Article 31(3)(b) VCLT.

<sup>41</sup> Useful Space, European Space Agency Kids (2013), <http://www.esa.int/esaKIDSen/Usefulspace.html>.

<sup>42</sup> e.g. for telecommunications, the service provider Orange; for navigation systems, the company TomTom.

commercial activity carried out in outer space; the issue is that space mining opens the door to an entirely new type of industry which will require exploiting non-renewable resources. Consequently, it will not be possible to re-establish the situation which existed before the exploitation of these resources because they will be forever lost. In such a situation, the call from the international community to decide over the issue at the international level rather than relying entirely on the interpretation of a 50-years-old treaty is understandable.<sup>43</sup>

Nonetheless, even though space mining is not prohibited *per se* and can be considered as being included in the freedom of use of outer space as provided by Article I of the Outer Space Treaty, this interpretation only stands so long as space mining does not violate other provisions of the Treaty.<sup>44</sup>

### **B. Sharing of benefits stemming from the utilization of space resources**

The right of States Parties to the Outer Space Treaty to freely use outer space to carry out activities includes an implicit authorization for commercial activities such as space mining. It is not without limits, though. Others rights and obligations provided by the same instrument must be considered and balanced.<sup>45</sup> One particular limitation, which, in our opinion, plays a crucial role, is that even though States are free to use outer space, they are required to do so for the ‘common benefit’ *i.e.* for the benefit of all countries.<sup>46</sup>

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<sup>43</sup> UN COPUOS (2016), *op. cit.* n. 10, p. 38.

<sup>44</sup> IISL DoS Study on Space Resource Mining, *op. cit.* n. 16, p.41.

<sup>45</sup> *Idem*, p. 31.

<sup>46</sup> Outer Space Treaty, Article I(1).

*1. Protecting the interests of developing countries: the 'common benefit' clause in the Outer Space Treaty*

It is worthy of note that the 'common benefit' clause, namely Article I paragraph 1, is the first provision of the Outer Space Treaty, indicating a particular emphasis on this aspect. The freedom to explore and use outer space only comes second.<sup>47</sup> The idea that States Parties must act in the interest of countries is thus of particular importance, and impacts the other provisions of the Treaty.<sup>48</sup>

Linked with the idea of a common benefit in the outcomes of space exploration, it is clear from the reading of Article I paragraph 1 and 2 that the Treaty emphasizes the rights of developing countries. Paragraph 1 provides that activities in outer space are the "province of all mankind" and shall benefit all countries "irrespective of their degree of economic or scientific development", while paragraph 2 insists on the fact that every country is free to use and explore outer space "without discrimination of any kind, on a basis of equality". Therefore, outer space, including the Moon and other celestial bodies, shall not be monopolized by a State or group of States for their own profit.<sup>49</sup>

As a result, States Parties to the Outer Space Treaty are under the obligation to share the benefits resulting from their use and exploration of outer space.<sup>50</sup> The binding nature of the 'common benefit' clause is unquestionable in the sense that it is part of a legally

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<sup>47</sup> The right of States Parties to freely use outer space is granted in Article I paragraph 2 of the Outer Space Treaty, directly after the 'common benefit' clause.

<sup>48</sup> E. W. Paxson, 1992 *op. cit.* n. 25, p. 491; S. Hobe (2009) *op. cit.* n. 2, pp. 36-40.

<sup>49</sup> *Idem*, pp. 37-40.

<sup>50</sup> E. W. Paxson (1992) *op. cit.* n. 25, p. 493.

binding instrument: a treaty.<sup>51</sup> What is less clear however is the extent of the States Parties' obligation following Article I paragraph 1 of the Treaty.<sup>52</sup>

This is of particular relevance considering that the States Parties are not the only ones bound by the 'common benefit' clause of the Outer Space Treaty; private companies are too. As repeatedly stressed by the International Institute of Space Law (hereinafter IISL), while not the first beneficiaries of the rights (and obligations) provided by the Treaty, private entities must abide by its provisions.<sup>53</sup>

Consequently, space mining start-ups such as the American Planetary Resource and the Japanese ispace Inc. have to integrate compliance with the treaty in their development, and ensure their activity do not solely benefit them but also the rest of the world. Considering that a private company's first goal is to make profits, such obligations appears as contradictory since they request that for-profit businesses share 'space benefits', *i.e.* the benefits resulting from activities carried out in outer space. Thus, it is primordial to have a clear understanding of what the concept of sharing 'space benefits' entails to see if it can be reconciled with the economic reality.

Unfortunately, Article I paragraph 1 of the Outer Space Treaty fails to define key notions of the concept such as what would constitute a 'space benefit' and how much

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<sup>51</sup> On the binding nature of international agreement, see. VCLT, Article 26. On the binding nature of the 'common benefit' clause itself, see. E. W. Paxson (1992) *op. cit.* n. 25, pp. 491-492.

<sup>52</sup> *Idem*, pp. 492-493; also see the Treaty on Outer Space: Hearings Before the Senate Committee on Foreign Relations, 90th Cong., 1st Sess. 1, 74 (1967) in Eric Husby, *Sovereignty and Property Rights in Outer Space*, 3 J. INT'L L. & PRAC 364 (1994).

<sup>53</sup> IISL, Statement by the Board of Directors of the IISL on Claims to Property Rights Regarding the Moon and Other Celestial Bodies (2004) [hereinafter Statement by the IISL Board of Directors, 2004]; IISL, Statement of the Board of Directors of the IISL, (2009); also see. S. Hobe (2009) *op. cit.* n. 2, pp. 33-34.

must be shared with the rest of the world.<sup>54</sup> Therefore, the ‘common benefit’ clause cannot be deemed “self-executing”<sup>55</sup> and must be interpreted in light of other agreement and State practices.<sup>56</sup>

## *2. Toward an ‘equitable’ sharing of the benefits: the ‘common heritage’ principle in the Moon Agreement*

The issue of sharing the benefits of outer space is not limited to the Outer Space Treaty. It was brought up again, in a slightly different form, with the ‘common heritage’ principle, during the drafting of the Moon Agreement adopted in 1979.<sup>57</sup> Akin to the ‘province of all mankind’ principle found in Article I paragraph 1 of the Outer Space Treaty, the concept of “common heritage of all mankind”<sup>58</sup> further developed the idea that outer space belongs to all countries.<sup>59</sup>

Among other things,<sup>60</sup> this new concept explicitly extends the *res communis* nature of outer space to the Moon’s natural resources.<sup>61</sup> As a result, “neither the surface nor the subsurface of the Moon, nor any part thereof or natural resources in place” can be

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<sup>54</sup> *Idem*, p. 36.

<sup>55</sup> E. W. Paxson (1992) *op. cit.* n. 25, p. 492.

<sup>56</sup> VCLT, Article 31.

<sup>57</sup> Moon Agreement, Article 11(1).

<sup>58</sup> *Ibid.*

<sup>59</sup> S. Hobe (2009) *op. cit.* n. 2, p. 37.

<sup>60</sup> There is no definite definition of the ‘common heritage’ principle. See, Fabio Tronchetti et al., *Article 11 of the Moon Agreement*, II in COLOGNE COMMENTARY ON SPACE LAW 394-395 (Stephan Hobe, Bernhard Schmidt-Tedd, & Kai-Uwe Schrogl eds., 2013) [hereinafter F. Tronchetti et al. (2013)].

<sup>61</sup> Article 11 paragraph 1 of the Moon Agreement provides that the “Moon and its natural resources are the common heritage of mankind” where Article I of the Outer Space Treaty only states that outer space shall be the province of all mankind.

appropriate.<sup>62</sup> By contrast, the 1967 Outer Space Treaty only prohibited the appropriation of outer space.<sup>63</sup> More importantly, the concept of ‘common heritage’ entails the establishment in the future of an international regime managing the exploitation of lunar resources.<sup>64</sup> Such a framework appears particularly relevant in the context of space mining activities. Unfortunately it was also one of the major reasons for its poor success: ultimately it was too constraining.<sup>65</sup> As a result, to date, only 17 States have ratified the Moon Agreement and none of the space-faring nations.<sup>66</sup>

Despite its limited success, the Moon Agreement does offer a valuable framework for reflection regarding how the benefits should be shared. Article 11 paragraph 7 in particular calls for “[a]n equitable sharing by all States Parties in the benefits derived from those resources”. The choice of the term ‘equitable’ rather than the term ‘equal’ is not without importance.<sup>67</sup> ‘Equitable’ refers to a “fair and impartial”<sup>68</sup> share of the benefits while ‘equal’ would refer to the “same in quantity, size, degree or value”<sup>69</sup>. The

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<sup>62</sup> Moon Agreement, Article 11 (3).

<sup>63</sup> Outer Space Treaty, Article II.

<sup>64</sup> Moon Agreement, Article 11(5).

<sup>65</sup> Francis Lyall, *On the Moon*, 26 JOURNAL OF SPACE LAW 132 (1998); Fabio Tronchetti, Stephan Hobe & Peter Stubbe, *Historical Background and Context of the Moon Agreement*, II in COLOGNE COMMENTARY ON SPACE LAW 336 (Stephan Hobe, Bernhard Schmidt-Tedd, & Kai-Uwe Schrogl eds., 2013).

<sup>66</sup> Status of International Agreements relating to activities in outer space as at 1 January 2017, UN COPUOS Legal Subcommittee, 56<sup>th</sup> Sess., at 12, UN Doc.

A/AC.105/C.2/2017/CRP.7 (2017),

<http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html>; Francis Lyall, *On the Moon*, 26 JOURNAL OF SPACE LAW 132 (1998) [hereinafter F. Lyall (1998)].

<sup>67</sup> F. Tronchetti et al. (2013) *op. cit.* n. 60, p. 398-399.

<sup>68</sup> Equitable, ENGLISH OXFORD DICTIONARIES, <https://en.oxforddictionaries.com/definition/equitable>.

<sup>69</sup> Equal, ENGLISH OXFORD DICTIONARIES, <https://en.oxforddictionaries.com/definition/equal>.

use of the term ‘equitable’ thus shows that the international community has settled on the fact that a distinction should be drawn between the States contributing or investing in the space venture and the rest of the world.<sup>70</sup> This is furtherly clarified by the second half of the sentence of paragraph 7 which provides that “the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration”. This provides a concrete approach of how ‘space benefits’ should be shared and shows the inclination of the international community to balance the interests at play rather than only targeting developing countries as recipients of the benefits of space exploration.<sup>71</sup>

### *3. Reaching a consensus: the Space Benefit Declaration*

The Moon Agreement shows the interest of the international community in clarifying the rule that ‘space benefits’ shall be shared; it also provides some concrete elements of reflection about the notion. However, and especially considering its poor success, it does not provide a definitive interpretation of the concept.

The issue was finally openly addressed at the UN in 1996 in order to solve the shortcomings of the ‘common benefit’ clause. As a result, the international community adopted the Declaration on International Cooperation in the Exploration and Use of

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<sup>70</sup> F. Tronchetti et al. (2013) *op. cit.* n. 60, p. 398.

<sup>71</sup> Steven Freeland, *Common heritage, not common law: How international law will regulate proposals to exploit space resources*, 35 QIL QDI 27 (2017), <http://www.qil-qdi.org/common-heritage-not-common-law-international-law-will-regulate-proposals-exploit-space-resources/> [hereinafter S. Freeland (2017)].



Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (hereafter Space Benefit Declaration)<sup>72</sup>.

It was clear that the provision in Article I of the Outer Space Treaty was not enough to ensure that space activities be carried “for the benefit and in the interest” of all countries.<sup>73</sup>

Indeed, by the late 1980s’s, it became apparent to the less developed countries that great benefits could come from using outer space; benefits that they were not experiencing.<sup>74</sup>

For instance, space technologies could benefits countries by mapping areas thus helping them develop “vast underused resources” and implement “natural disaster management systems”.<sup>75</sup> In the end, rather than forcing space-faring nations to share the “tangible”<sup>76</sup> benefits of space as the developing countries initially wanted, it was agreed that ‘international cooperation’ is the best instrument to promote higher living standards in all countries.<sup>77</sup> Hence, the Space Benefit Declaration thus attempt to define what ‘international cooperation’ entails.

The Declaration continuously balances the interests of the developing and more developed countries. Similarly to the Moon Agreement, it promotes an “equitable”

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<sup>72</sup>GA Res 51/122, UNGA, 83<sup>rd</sup> Sess., UN Doc. A/RES/51/122 (1996) [hereinafter Space Benefit Declaration].

<sup>73</sup> S. Freeland (2017) *op. cit.* n. 71, p. 27; E. W. Paxson (1992) *op. cit.* n. 25, p. 493.

<sup>74</sup> *Ibid.*

<sup>75</sup> United Nations, *Benefits from Space Exploration Must Be Shared among All Nations, Fourth Committee Is Told*, October 13, 2004, <https://www.un.org/press/en/2004/gaspd291.doc.htm>.

<sup>76</sup> Fabio Tronchetti & Stephan Hobe, *Space Benefit Declaration Historical Background and Context*, III in COLOGNE COMMENTARY ON SPACE LAW 315 (Stephan Hobe, Bernhard Schmidt-Tedd, & Kai-Uwe Schrogl eds., 2015) [Hobe & F. Tronchetti, Space Benefit Declaration].

<sup>77</sup> *Ibid.*; E. W. Paxson (1992) *op. cit.* n. 25, p. 495.

relation between countries.<sup>78</sup> The Space Benefit Declaration also preserves the sovereignty of the Signing Parties by allowing them to decide on “all aspects of their participation in international cooperation” including with whom cooperate and how.<sup>79</sup> International cooperation can, for instance, be “global, multilateral, regional or bilateral”.<sup>80</sup> Therefore, ‘international cooperation’ and by extension the sharing of space benefits with “all countries” does not actually require to cooperate with *all* countries. The Space Benefit Declaration simply works as an incentive to enable developing countries to participate on fair terms in space initiatives.<sup>81</sup>

Interestingly enough, the actual goals of international cooperation are rebuked to the 5<sup>th</sup> paragraph, half-way through the Space Benefit Declaration. This is where the idea of what may constitute a space benefit is shaped, international cooperation being the best instrument to share said benefits.<sup>82</sup> Following Paragraph 5, international cooperation aims, among other things, at “facilitating the exchange of expertise and technology among States”. Therefore, it can be deduced that sharing technologies and ‘know-how’ is one way to conduct activities in outer space “for the benefit and in the interest of all countries”.<sup>83</sup> It also means that ‘space benefits’ are not necessarily financial in their

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<sup>78</sup> Space Benefit Declaration, Paragraphs 2 and 3.

<sup>79</sup> S. Hobe (2009) *op. cit.* n. 2, p. 42.

<sup>80</sup> Space Benefit Declaration, Paragraph 4.

<sup>81</sup> *Idem*, Paragraphs 2 and 3.

<sup>82</sup> *Supra*, p. 19.

<sup>83</sup> Carl Q Christol, *The future of space law*, SPACE LAW : DEVELOPMENT AND SCOPE SPACE LAW 236 (1992).

form.<sup>84</sup> This rejoins the idea expressed above that space technologies or more precisely their application, is what could benefit the most developing countries.<sup>85</sup>

#### *4. Operative sharing of space benefits*

In the end, however, it is the resolution on Principles Relating to Remote Sensing of the Earth from Outer Space (hereinafter Remote Sensing Principles)<sup>86</sup>—adopted 10 years before the Space Benefit Declaration by the UN—that gives the most significant indications on how to share and what constitutes ‘space benefits’.

Unsurprisingly, the Remote Sensing Principles recalls (twice!) the duty of Signing Parties to carry out remote sensing activities “for the benefit and in the interest of all countries”.<sup>87</sup> But contrary to the above mentioned instruments in (1), (2) and (3), this non-binding resolution from 1986 is accompanied by concrete measures.

Principle VI of the Remote Sensing Principles, for instance, provides that to “maximize the availability of benefits [...] States are encouraged, through agreement or other arrangement, to provide for the establishment and operation of data collecting and storage stations, and storage stations and interpretation facilities”. Principle VII mentions providing “technical assistance” on “mutually agreed terms”. Once again, the sharing of technologies and ‘know-how’ are singled out as effective means to share the benefits of space. Furthermore, the fact that this is done on a contractual basis offers

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<sup>84</sup> S. Freeland (2017) *op. cit.* n. 71, p. 28.

<sup>85</sup> *Supra*, p. **Error! Bookmark not defined..**

<sup>86</sup> GA Res 41/65, UN GA, 95th Sess., UN Doc. A/RES/41/65 (1986) [hereinafter Remote Sensing Principles].

<sup>87</sup> *Idem*, in Principle II specifically for remote sensing activities and in Principle IV by referring to Article I of the Outer Space Treaty.

guarantees to all parties involved. It ensures they all agree to the terms since, without the exchange of consent, there is no valid contract. The Remote Sensing Principles also stresses the fact that the terms must be mutually agreeable to ensure that the weak party, namely the one that cannot benefit directly from space activities, is not abused.

Even more interesting is Principle XII which organizes for “sensed States” *i.e.* the State whose data are remotely collected, to have access to said data “on reasonable costs terms”. The Remote Sensing Principles makes it clear that sharing benefits does not have to be free. However, it does not mean that the selling party is free to do whatever it wants. The term “reasonable costs” has a very specific meaning: it is generally accepted as referring to the “cost of filing a user request” mechanism (hereinafter COFUR).<sup>88</sup> It literally means that the consumer will only pay what it costs the organization to make the requested item available.<sup>89</sup> This includes for instance the costs for the medium, the postage and the packaging.<sup>90</sup> A distinction however is commonly drawn between the price of the raw product and of the value-added product, namely for remote sensing activities, the price of “primary data” and “processed data”. The latter requiring more work to be tailored to the client’s needs, this justifies a supplementary charge. Eventually, the COFUR mechanism is a simple and effective means to ensure that a client, even with limited financial means, will be able to afford the product and that the provider will not lose money over providing it. Hence, sharing benefits does not necessarily represent a loss of profit *per se* for private entities. It only means that they are not able to make profits out of every single advantage they gain from space.

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<sup>88</sup> Lesley Jane Smith, *Remote Sensing Principle XII, III in COLOGNE COMMENTARY ON SPACE LAW* 167 (Bernhard Schmidt-Tedd, Kai-Uwe Schrogl, & Stephan Hobe eds., 2015).

<sup>89</sup> COFUR USA p. 27 and South Africa p. 3.

<sup>90</sup> COFUR South Africa, p. 4.

### 5. Case study: ispace Inc.

At the beginning of this part, we wondered how the ‘common benefit’ clause could be reconciled with the economic reality of space mining. From the previous development, it has been made apparent that sharing the benefits from activities carried out in outer space does not require a private company to share the physical benefits it gained. Hence, a space mining company will not be forced to share the lunar resources it extracted.<sup>91</sup> Nor will it have to share its profits with other countries.<sup>92</sup> However, these enterprises have to find alternative means to fulfill their obligation under the Outer Space Treaty.

For instance, ispace Inc., the Japanese start-up, is interested in mining the water ice found at the poles of the Moon.<sup>93</sup> Once the water extracted, they will be able to break down the molecules to produce efficient rocket fuel which will then be used by lunar fuel stations.<sup>94</sup> This service will allow other entities to ‘re-fill’ satellites and space transportation. In parallel, ispace Inc. is also developing a payload system that will allow its customers to send scientific material, such as a spectrometer, on the Moon by using one of one of the company’s rovers.<sup>95</sup> In the end, ispace’s goal is to develop “micro-robotic technology to provide a low-cost and frequent transportation service to

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<sup>91</sup> E. W. Paxson (1992) *op. cit.* n. 25, p. 492.

<sup>92</sup> S. Freeland (2017) *op. cit.* n. 71, p. 28.

<sup>93</sup> ispace Inc., ISPACE, <http://ispace-inc.com/>.

<sup>94</sup> *Ibid*; PAUL D SPUDIS, THE VALUE OF THE MOON: HOW TO EXPLORE, LIVE, AND PROSPER IN SPACE USING THE MOON’S RESOURCES 11-14 (2016).

<sup>95</sup> Luxembourg Ministry of the Economy, LUXEMBOURG AND ISPACE, A TOKYO-BASED LUNAR ROBOTIC EXPLORATION COMPANY, SIGN MoU TO CO-OPERATE WITHIN THE SPACERESOURCES.LU INITIATIVE (2017), <http://www.businesswire.com/news/home/20170302005800/en/Luxembourg-ispace-Tokyo-Based-Lunar-Robotic-Exploration-Company>.

and on the Moon, conduct lunar surface exploration to map, process, and deliver resources to [their] customers in cislunar space”.<sup>96</sup>

The activity of the start-up thus focuses on enabling other entities to participate in space exploration in return for financial compensation. Despite its for-profit nature, ispace Inc.’s development complies with the requirement to act “for the benefit and in the interests of all countries” as stated in Article I of the Outer Space Treaty. In the case of ispace Inc., the start-up does not only help entities access outer space, it also intends to assist them directly in outer space by producing propellant and fuel stations. Therefore, ispace Inc.’s client will be able to benefit from the company’s technology and ‘know-how’. The payment of a financial compensation is there to cover the service provided and is not in opposition with the ‘common benefit’ clause, but is, as noted before, in line with the economic reality of space activities.

### **C. The paradox of non-appropriation of outer space**

Ultimately, one must irrevocably consider the principle of non-appropriation laid down in Article II of the Outer Space Treaty when dealing with the question of the conformity of space mining activities with international space law. It provides: “outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means”.<sup>97</sup> This principle works as a safeguard and reinforces the ‘common benefit’ clause of Article I.<sup>98</sup>

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<sup>96</sup> ispace Inc., ISPACE, <http://ispace-inc.com/>.

<sup>97</sup> Article II of the Outer Space Treaty.

<sup>98</sup> Steven Freeland & Ram Jakhu, *Article II, I* in COLOGNE COMMENTARY ON SPACE LAW 45-48 (Stephan Hobe, Bernhard Schmidt-Tedd, & Kai-Uwe Schrogl eds., 2009) [hereinafter S. Freeland and R. Jakhu (2009)].

It ensures that no State will claim exclusive rights or jurisdiction over outer space, the Moon and asteroids. At the same time, it raises another issue about space mining, beyond the one of commercial use: the very question of whether space mining activities constitutes an appropriation of outer space.<sup>99</sup>

This idea that outer space cannot be appropriated is longstanding. It was first unanimously adopted in 1961 during the sixteenth plenary meeting of the UNGA.<sup>100</sup> The principle was then developed and included in the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space<sup>101</sup> of 1963, to finally be implemented in a legally binding instrument: the Outer Space Treaty.

### *1. Challenging the 'non-appropriation' principle*

The doctrine of non-appropriation did not stand without being challenged; it was first opposed to in 1976 by a group of eight Equatorial countries<sup>102</sup> claiming that they were not bound by Article II of the Outer Space Treaty.<sup>103</sup> In a common Declaration—the Declaration of the First Meeting of Equatorial Countries (hereinafter Bogotá

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<sup>99</sup> On the character of asteroids and near-Earth objects as 'celestial bodies', see. International Astronomical Union, Definition of a Planet in the Solar System, IAU Doc. RES/B5 (2006). On the issue of space mining activities contradicting Article II, see the views expressed by national delegations in UN COPUOS (2017) *op. cit.* n. 9, paragraphs 231, 243 and 248.

<sup>100</sup> *Ibid*; GA Res. 1721 (XVI) A(1)(b), 16<sup>th</sup> Sess., UN GAOR, U.N. Doc. A/RES 1721(XVI) (1961).

<sup>101</sup> 1963 Legal Principles Declaration *op. cit.* n. 13.

<sup>102</sup> Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda and Zaire.

<sup>103</sup> V. S. Vereshchetin and G. M Danilenko *op. cit.* n.13, p. 131.

Declaration)<sup>104</sup>, the eight States argued that the “the segments of geostationary synchronous orbit are part of the territory over which Equatorial States exercise their national sovereignty”<sup>105</sup>; thus claiming sovereignty over the part of outer space directly above their territory.

But the Bogotá Declaration did not really convince the international community. Many States considered that the principle of non-appropriation was part of international customary law and thus binding all States regardless of their adherence to the Treaty.<sup>106</sup> For instance, the Soviet Union declared that the principle of non-appropriation “had now acquired the status of norms of customary international law and were binding even upon States which had not yet signed the Treaty”<sup>107</sup>.

The provision of Article II of the Outer Space Treaty was challenged a second time when a private person claimed ownership over an asteroid. In 2001, the American National Aeronautics and Space Administration (hereinafter NASA) landed a robotic spacecraft on Asteroid 433 Eros as part of one of its mission.<sup>108</sup> A man named Gregory Nemitz claimed that the asteroid was his, and demanded NASA pay parking and storage fee. NASA refused to pay on the basis that Nemitz had “no foundation in law”<sup>109</sup> for his

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<sup>104</sup> Declaration of the First Meeting of Equatorial Countries, Bogotá, Colom., Dec. 3, 1976, reprinted in II MANUAL ON SPACE LAW 383 (Nandasiri Jasentuliyana & Roy S. K. Lee eds., 1979) [hereinafter The Bogotá Declaration].

<sup>105</sup> *Ibid.*

<sup>106</sup> S. Freeland and R. Jakhu (2009) *op. cit.* n. 98, p. 56; V. S. Vereshchetin and G. M Danilenko *op. cit.* n. 13, p. 32-33.

<sup>107</sup> UN Doc. A/AC.105/C.2/SR373, at 6 (1982) in V. S. Vereshchetin and G. M Danilenko *op. cit.* n. 13, p. 33.

<sup>108</sup> Eros Project: Legal Actions, THE EROS PROJECT, <http://www.erosproject.com/legal.html?source=ErosProject> (last visited Aug 29, 2017).

<sup>109</sup> S. Freeland and R. Jakhu (2009) *op. cit.* n. 98, p. 56.



claim; a point of view that was shared by the United States' Department of States which considered the claim "without legal basis",<sup>110</sup>.

As anecdotal as it seems, the private claim to ownership over an asteroid raised a significant legal question, *i.e.* whether the principle of non-appropriation was limited to State appropriation. This is why the relation of private entities with the Outer Space Treaty had to be further clarified at the international level by the IISL.

In 2004, the IISL Board of Directors issued a statement refuting the validity of deeds selling plots of lands on the Moon.<sup>111</sup> The reasoning was that following Article VI of the Outer Space Treaty, private entities are allowed to operate in outer space so long as they are authorized and supervised by their States. Since States are bound by Article II of the Outer Space Treaty they cannot approve actions that are contrary to their international obligation.<sup>112</sup> Hence, they cannot recognize the validity of deeds selling plots of the Moon since it would constitute an appropriation in the sense of Article II. Therefore, the use of the term "national appropriation" in Article II is not exclusive of non-governmental entities and the principle of non-appropriation must be respected by private companies.

## *2. Excluding traditional means of acquisition of titles: "use" and "occupation"*

It is interesting that the drafters chose to call attention to claims of sovereignty by "use" or "occupation" where they could have simply said that "outer space is not subject to

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<sup>110</sup> *Ibid.*

<sup>111</sup> *Ibid*; IISL Board of Directors (2004) *op. cit.* n. 53.

<sup>112</sup> The IISL Board of Directors reaffirmed its position on the binding force of the Outer Space Treaty upon private entities, see IISL Board of Directors (2009) *op. cit.* n. 53; S. Freeland (2017) *op. cit.* n. 71, p. 25.

national appropriation” or that it could not be appropriated by any means. Instead, Article II reads “outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means”.

The emphasis on the terms “use” and “occupation” is explained by the fact that those are two means to create titles over lands, or in the case of States, claim sovereignty.<sup>113</sup> Following State practice, the prerogative to “use” is a component of the right of property.<sup>114</sup> Similarly, under international law effective “occupation” is a means for a State to acquire sovereignty over a territory *terra nullius i.e.* over a territory which no one has claimed.<sup>115</sup> Consequently, the reference to appropriation by use or occupation is to be understood as signifying that no amount of use or occupation will enable a State to extend its sovereignty over outer space.<sup>116</sup> The addition of the expression ‘by any other means’ of Article II of the Outer Space Treaty thus serves as a “catch all phrase”<sup>117</sup>.

This particular focus on appropriation by claim of “use or occupation” shows the intent of States to prevent a repeat of the XIX<sup>th</sup> century where European countries rushed to conquer Africa or more recently Antarctica.<sup>118</sup> The purpose of Article II of the Outer

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<sup>113</sup> R. Lee (2004) *op. cit.* n. 13, p. 135

<sup>114</sup> Protocol 1 to the European Convention for the Protection of Human Rights and Fundamental Freedoms, entered into force May 18 1954, art. 1, 213 U.N.T.S. 262; American Convention on Human Rights, entered into force July 18 1978, art. 21(1) 1144 U.N.T.S. 123; African Charter on Human and Peoples' Rights, entered into force Oct. 21 1986, §186, 1520 U.N.T.S. 217.

<sup>115</sup> Island of Palmas Case (US v Netherlands) (1928) II RIAA 829, paragraphs 30-31, 160.

<sup>116</sup> S. Freeland and R. Jakhu (2009) *op. cit.* . n. 98, p. 53.

<sup>117</sup> *Ibid.*

<sup>118</sup> UN COPUOS (2017) *op. cit.* n. 9, p. 29 ; R. Lee (2004) *op. cit.* n. 13, p. 134 ; Sylvain Venayre, Conférence de Berlin (1884-1885) Encyclopædia Universalis,

Space Treaty thus primarily aims to avoid new conflicts between States over sovereignty rights in outer space.<sup>119</sup>

This opinion however has been objected to and is not shared by Gorove for instance. Gorove favors a literalist approach of appropriation.<sup>120</sup> In his opinion, the concept of appropriation is linked to the duration of the use of the thing.<sup>121</sup> In that sense, a temporary use of outer space would not constitute an appropriation with regards to Article II of the Outer Space Treaty. It is the exclusivity of the use that entails appropriation.<sup>122</sup> His interpretation of the non-appropriation principle has merits from a factual point of view: if a State permanently and exclusively uses an asteroid, in the end, it has the same *de facto* effect as appropriation. From a legal standpoint however, it is our opinion that an exclusive use of say—an asteroid, would not amount to appropriation in the sense of Article II without the intent of the entity to own the asteroid.

For instance, in the case of a State operating alone on an asteroid for an unlimited amount of time, it would be preposterous to accuse it of appropriation for the sole reason that no other entity decided to operate in the same place. However, if the same State was to refuse access to the asteroid to other space actors and thus to “exclude” them, then it would qualify as a violation of Article II of the Outer Space Treaty. But

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<http://www.universalis.fr/encyclopedie/berlin-conference-de-1884-1885/>; Olivier Tallès, *La deuxième conquête de l'Antarctique*, LA CROIX, June 3, 2016, <http://www.la-croix.com/Monde/La-deuxieme-conquete-Antarctique-2016-06-03-1200766190>.

<sup>119</sup> E. W. Paxson (1992) *op. cit.* n. 25, p. 494.

<sup>120</sup> R. Lee (2004) *op. cit.* n. 13, p. 136.

<sup>121</sup> Stephen Gorove, *Interpreting Article II of the Outer Space Treaty*, 37 FORDHAM LAW REVIEW 349–354 (1969).

<sup>122</sup> *Ibid.*

that would be because the State intended to be the only one accessing permanently the asteroid.<sup>123</sup>

Eventually, it remains clear that land or areas of outer space cannot be owned by anyone, State or non-State. But are space resources subject to the same regime as land and areas? Recent discussions at the UN COPUOS show that it might not be the case.<sup>124</sup>

### *3. Appropriation of outer space: the 'area vs. resources' problem*

The legal status of celestial bodies is clear: they are non-appropriable and open for exploration.<sup>125</sup> The status of natural resources in outer space however remains uncertain,<sup>126</sup> the Outer Space Treaty making no reference to natural resources contained by celestial bodies. It is thus unsure whether these natural resources are subject to the prohibition of appropriation under Article II of the Treaty.

Answering this question is central to consider the compliance of space mining activities with the Outer Space Treaty since space mining will entail the consumption of resources *i.e.* their appropriation. For some States, this absence of explicit prohibition is a sign

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<sup>123</sup> The *animus occupendi* is one of the three elements constituting occupation, along with *terra nullius* and the taking of possession, see footnote 11 in Manfred Lachs, *The Legal Regime of Outer Space and Celestial Bodies*, in *THE LAW OF OUTER SPACE: AN EXPERIENCE IN CONTEMPORARY LAW-MAKING*, BY MANFRED LACHS, REISSUED ON THE OCCASION OF THE 50TH ANNIVERSARY OF THE INTERNATIONAL INSTITUTE OF SPACE LAW 48 (2010); John P Grant & Clive Parry, *ANUMUS OCCUPENDI* ENCYCLOPAEDIC DICTIONARY OF INTERNATIONAL LAW (3rd ed. 2009).

<sup>124</sup> T. Masson-Zwaan (2017) *op. cit.* n. 124, p. 8; UN COPUOS (2017) *op. cit.* n. 9, paragraph 231.

<sup>125</sup> Outer Space Treaty, Articles I and II ; Fabio Tronchetti, *CURRENT INTERNATIONAL LEGAL FRAMEWORK APPLICABILITY TO SPACE RESOURCE ACTIVITIES* (2017), <http://www.unoosa.org/documents/pdf/copuos/lsc/2017/symp-01.pdf>.

<sup>126</sup> *Ibid.*

that space resources can be appropriated.<sup>127</sup> This interpretation of Article II of the Outer Space Treaty was acknowledged by the IISL in 2015 in a position paper on space resource mining.<sup>128</sup> The IISL stated that the lack of explicit prohibition could be understood as allowing the appropriation of space resources under the Outer Space Treaty. Nevertheless, the IISL noted that it was one “possible interpretation” that remained to be confirmed by other States.<sup>129</sup> This remark is coherent with the rules of interpretation of treaties since subsequent practice established by the State Parties can be used to interpret a treaty.<sup>130</sup> In the case at hand, State practice is not completely helpful, since, as noted before, the international community is divided on the question.<sup>131</sup> It can be said, however, that the majority of the international community appears to lean towards an interpretation allowing the appropriation of natural resources; the core discussion being focused on whether a national or international framework should be favored rather than on the question of appropriation itself.<sup>132</sup>

Once again, the Moon Agreement sheds some light; Article 11 paragraph 2 of the Agreement forbidding the appropriation of outer space. Yet, paragraph 5 of the same Article provides for the establishment in the future of an international regime regulating the exploitation of natural space resources. Consequently, it can be inferred that the

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<sup>127</sup> See for instance the example of the United States and Luxembourg which adopted a national law expressly allowing the appropriation of natural resources in space: Title IV of the CSLCA *op. cit.* n. 8 and Loi luxembourgeoise sur l’exploration et l’utilisation des ressources de l’espace *op. cit.* n.8.

<sup>128</sup> IISL, Position Paper on Space Resource Mining (2015) [hereinafter IISL Position Paper (2015)].

<sup>129</sup> *Ibid.*

<sup>130</sup> VCLT, Article 31(3)(b).

<sup>131</sup> UN COPUOS (2017) *op. cit.* n. 9.

<sup>132</sup> DIGITAL RECORDINGS OF THE LEGAL SUBCOMMITTEE, (2017), <https://new-icms.unov.org/DocumentRepositoryIndexer/GetDocInOriginalFormat.drsx?DocID=ebb0256e-dd0a-4c9b-8698-7daab1a51b09>.

principle of non-appropriation does not preclude the exploitation of space resources. Furthermore, the strong statement in Article 11 paragraph 3 that resources “in place”<sup>133</sup> cannot be appropriated by any entity whatsoever can also be interpreted as meaning that resources no more “in place”, *i.e.* extracted resources, could be owned.<sup>134</sup>

This distinction between “*in situ*” resources and extracted resources is not without sense. *In situ* resources are by definition still part of the asteroid or other celestial body that contains it. Hence, allowing an entity to claim property rights over a resource that is not yet extracted comes back to sanctioning the appropriation of the part of outer space that contains the resources.<sup>135</sup> Now, this would without a doubt constitute a violation of non-appropriation principle.

Therefore, it is our opinion that Article II of the Outer Space Treaty does not apply to extracted resources and that only *in situ* resources should not be considered appropriable as they are an integral part of outer space. Consequently, while space mining companies would be entitled to the resources they extract, they should not be allowed to have preemptive property rights over resources to be extracted.

#### 4. Exploitation ‘out of existence’ of celestial bodies

Admitting that space resources are appropriable still raises a host of supplementary issues. Freeland, for instance, notes that authorizing the extraction raises the question of the extent to which an entity is allowed to mine a celestial body.<sup>136</sup> As noted before,

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<sup>133</sup> *i.e.* natural resources that are physically attached to the celestial body.

<sup>134</sup> Frans von der Dunk, *Private Property Rights and the Public Interest in Exploration of Outer Space*, BIOL THEORY BIOLOGICAL THEORY 5 (2017).

<sup>135</sup> F. Tronchetti (2015) *op. cit.* n. 15.

<sup>136</sup> S. Freeland & R. Jakhu (2009) *op. cit.* n. 98, pp. 53-54.

asteroids contain iron, platinum and water; the latter while considered limitless on Earth is precious and absolutely essential for the development of a long-term presence in space.<sup>137</sup> It would thus be logical for private companies to want to extract the maximum of resources out of the celestial body they are mining to make optimal benefits. However, it obviously comes to a point where nothing is left to mine, where the celestial body is mined ‘out of existence’.<sup>138</sup>

In Freeland’s opinion, even though it could be argued that this exploitation of a small celestial body out of existence “might not constitute an act of appropriation within the scope of Article II, it may still be unlawful under the current legal regime”<sup>139</sup>, namely under the provisions of the *corpus iuris spatialis*.

In our opinion, this exploitation of a celestial body to “out of existence” by means of over mining would not constitute, from a legal standpoint, an appropriation in the sense of Article II of the Outer Space Treaty. As noted before, the notion of appropriation is linked to the idea of claiming ownership over a celestial body which would require the intent to appropriate the celestial body. But in the case at hand, it is not the small asteroid *per se* that the mining entity claims but the resources it contains. The appropriation of the celestial body, in the sense that no one else will be able to use, is a consequence resulting from over mining. Therefore, it would be a *de facto* appropriation of the celestial body rather than a *de lege* appropriation. Now, as noted before, Article II of the Outer Space Treaty only aims at avoiding *de lege* claims by ensuring *inter alia*

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<sup>137</sup> JOHN S LEWIS & DAVID GUMP, ASTEROID MINING 101: WEALTH FOR THE NEW SPACE ECONOMY 99 (2015).

<sup>138</sup> S. Freeland & R. Jakhu (2009) *op. cit.* n. 98, pp. 53-54; S. Freeland (2017) *op. cit.* n. 71, p. 23.

<sup>139</sup> *Ibid.*

that no amount of use or occupation gives rights to titles in outer space. Consequently, neither can the extreme use of a celestial body by means of resources extraction.

Freeland nonetheless raises a valid point when he says that regardless of the question of appropriation, the exploitation of a celestial body out of existence would certainly violate other aspects of space law. We do agree with Freeland that such extreme exploitation would breach, among other things, the ‘due regard’ clause laid down in Article IX of the Outer Space Treaty. Article XI provides that “States Parties to the Treaty [...] shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty”. The ‘due regard’ clause thus requires States to balance their own interests in outer space with those of others. Therefore, space mining actors will be expected to show “a certain standard of care, attention and observance”<sup>140</sup> which exploiting an asteroid out of existence is far from demonstrating.

Another nuance we have to introduce in Freeland’s reasoning is that his remarks do not apply solely to the case of full destruction of a celestial body. It would be ludicrous to leave behind a small piece of asteroid and pretend to fulfill literally an obligation under the Outer Space Treaty. How small is too small, so small that it violates the ‘due regard’ clause of Article IX? Such a question will lead to a never ending issue, if the future legal framework for space mining activities does not ensure that what is left from space mining is merely small useless pieces of asteroids.

Even if these considerations are not a priority at the time, they are just another facet of the more general concern: to define the objectives and scope of a new international

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<sup>140</sup> Sergio Marchisio, *Article IX, I* in COLOGNE COMMENTARY ON SPACE LAW 169–182 (Stephan Hobe, Bernhard Schmidt-Tedd, & Kai-Uwe Schrogl eds., 2009).



framework which will have to decide on the compliance of resource utilization with the principles of space law.<sup>141</sup> The issue of preserving other States' interests, or of determining how benefits should be shared,<sup>142</sup> can only arise from the utilisation of space resources. Should the international community agree that space mining is prohibited under the Outer Space Treaty, these issues would be non-existent. Therefore, it is primordial to first concern ourselves with the legality of space resource utilization.

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<sup>141</sup> The numbering of the eighteen building blocks defined in April 2016 by the Hague Space Resources Governance Working Group shows that the priority is on defining the objectives and scope of the future international regime for resources utilization, see. International Institute of Air and Space Law, THE HAGUE SPACE RESOURCES GOVERNANCE WORKING GROUP LEIDEN UNIVERSITY (2017), <http://law.leiden.edu/organisation/publiclaw/iiasl/working-group/the-hague-space-resources-governance-working-group.html#recent-developments>.

<sup>142</sup> S. Freeland (2017) *op. cit.* n. 71, p. 23.

## Section 2. National space laws and use of space resources

The establishment of a legal and regulatory framework for space mining activities is without a doubt a necessity. Space mining companies need legal guarantees to actively invest themselves in the development of their activities in space.<sup>143</sup> The technology required to access, map and extract resources from celestial bodies has almost reached the stage of implementation and companies are getting ready to take the next step of space exploration.<sup>144</sup> It is therefore time to start developing rules specifically for the utilization of space resources.

Without a clear understanding of where space mining activities stands with regards to international space law, the only legal boundary for space mining actors is the one imposed by Article VI of the Outer Space Treaty, namely the obligation for private entities to get the authorization of the State before conducting activities in space. From the State's viewpoint, this minimal requirement can be understood in two significantly different ways. One possibility is to consider there is currently no restriction on space mining and grant largely authorizations until the establishment of another treaty. The other possibility is to consider that any utilization of space resource has to comply with a national legal framework. In this matter, we share the opinion of Masson-Zwaan and Palkovitz that “waiting until States reach an international agreement relating to space resource mining would mean giving a hand to an unregulated space industry”.<sup>145</sup> In this

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<sup>143</sup> ETIENNE SCHNEIDER ABOUT THE IMPORTANCE OF THE LEGAL AND REGULATORY FRAMEWORK, (2017), <https://www.facebook.com/SpaceResources.lu/videos/1842846859363340/> [hereinafter E. Schneider about the importance of the legal and regulatory framework of Luxembourg].

<sup>144</sup> Mike Wall *op. cit.* n. 6.

<sup>145</sup> T. Masson-Zwaan (2017) *op. cit.* n. 124, pp. 17-18.

context, the adoption by the United States and Luxembourg of a national framework for space mining activities should be, if not welcomed, considered as the lesser evil.

This opinion however was not shared by a large part of the international community. Russia, for instance, affirmed that the adoption of the American Commercial Space Launch Competitiveness Act of 2015 (hereinafter CSLCA)<sup>146</sup> was a “manifestation of total disrespect for the international law order”.<sup>147</sup> It is thus necessary to address the question of national legal frameworks for space resources utilization in the light of current “international law order”. This second section will thus analyze how respectively the United States (A) and Luxembourg (B) regulate space mining activities in conformity with their international obligations.

### **A. United States**

The CSLCA was signed into law on November 25, 2015, making the United States the first country in the world to adopt a national regulatory framework for space mining activities. The Act in itself encompasses four titles; Titles I to III essentially amend existing provisions respectively on the licensing regime for launches and commercial remote sensing, and renames the office of space commerce. The real novelty comes from Title IV.

Commonly known as the ‘Space Resource Exploration and Utilization Act of 2015’ (hereinafter Title IV)<sup>148</sup>, Title IV specifically authorizes citizens of the United States

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<sup>146</sup> HR 2262, available at [www.congress.gov/bill/114th-congress/house-bill/2262/text](http://www.congress.gov/bill/114th-congress/house-bill/2262/text).

<sup>147</sup> Working paper submitted by the Russian Federation, STSC, Sess. 53rd, at 7, UN Doc A/AC.105/C.1/2016/CRP.15 (2016).

<sup>148</sup> Title IV of the CSLCA, *op. cit.* n. 8.

(hereinafter U.S. citizens) “to possess, own, transport, use, and sell the asteroid resource or space resource” they obtain.<sup>149</sup>

### *1. Definition of ‘space resource’*

To that end, Title IV starts by defining a key term of space mining activities, namely what constitutes a ‘space resource’. Accordingly, Section 402 §51301 (2) defines a ‘space resource’ as “an abiotic resource *in situ* in outer space” including minerals and water.<sup>150</sup> Consequently, a ‘space resource’ is a resource originating and located in outer space excluding biological life.<sup>151</sup>

It must also be noted that the Title defines in §51301 (1) the term ‘asteroid resource’. The definition in itself is nothing special; an ‘asteroid resource’ is a ‘space resource’ “found on or within an asteroid”<sup>152</sup>. Significantly enough, ‘asteroid resource’ is defined first and ‘space resource’ after even though the former is defined in function of the latter. This clarification, as well as the order in which the definitions are written, thus show that the primary focus of the United States is on mining asteroids as opposed to, for instance, lunar resources. Yet, when explaining the object and purpose of Title IV, *i.e.* the “commercial exploration and commercial recovery”<sup>153</sup> of resources, the drafters chose to refer only to ‘space resources’ rather than ‘asteroid resources’ or both.

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<sup>149</sup> *Idem*, §51303.

<sup>150</sup> *Idem*, §51301(2)(B).

<sup>151</sup> K. G. Orphanides, AMERICAN COMPANIES COULD SOON MINE ASTEROIDS FOR PROFIT WIRED UK (2015), <http://www.wired.co.uk/article/how-to-mine-asteroids-for-fun-and-profit>.

<sup>152</sup> Title IV of the CSLCA, *op. cit.* n. 8, §51301(1).

<sup>153</sup> *Idem*, §51302.

## 2. Commercial purpose of Title IV

According to §51302, the purpose of Title IV is to “facilitate commercial exploration and commercial recovery of space resources by the U.S. citizens”. Therefore, the national law adopted by the United States clearly affirms the rights of U.S. citizens, to explore and exploit outer space for commercial purpose.

At first glance, and reference to the exploitation of space resources aside, this law only states the obvious: private entities are allowed to conduct profitable activities in outer space. But as recently pointed out by Luxembourg’s Deputy Prime Minister and Minister of Economy Etienne Schneider, the “United Nations’ Space Treaty of 1967 does not touch upon [the] question about who can do what in space, economically speaking”.<sup>154</sup> Indeed, as noted in section 1, the Outer Space Treaty does not expressly refer to commercial activities nor does it explicitly states that non-State entities are also beneficiaries of the freedoms the Treaty provides.<sup>155</sup> These possibilities were only clarified by subsequent interpretations of the Treaty.<sup>156</sup>

This being said, it remains that Title IV’s main purpose is “to promote the right of U.S. citizens to engage in commercial exploration for and commercial recovery of space resources”.<sup>157</sup> To that end, the national law preconizes minimum governmental intervention in the sense that governmental barrier should not discourage “the development in the United States of economically viable, safe, and stable [space

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<sup>154</sup> E. Schneider about the importance of the legal and regulatory framework of Luxembourg (2017) *op. cit.* n. 143.

<sup>155</sup> Also see, S. Hobe (2009) *op. cit.* n. 2, pp. 33-36.

<sup>156</sup> See for instance, IISL Board of Directors (2004 & 2009) *op. cit.* n. 53.

<sup>157</sup> Title IV of the CSLCA, *op. cit.* n. 8, §51302(a)(3).

mining] industries”.<sup>158</sup> Hence, the role of the State should be limited to ensuring space mining activities carried out by U.S. citizens do not “jeopardize public health and safety, safety of property, U.S. national security or foreign policy interests, or international obligations [of the U.S.]”<sup>159</sup>. As minimalistic such restrictions may seem, they still mean that space mining companies are not allowed to do as they want. As a matter of fact, Title IV subjects its applicability to well-defined legal conditions.

### *3. Legal conditions*

In order to benefit from the rights guaranteed under Title IV, such as the recognition of property rights over extracted resources, space mining entities have to fulfill three legal conditions: (i) the entity must be a U.S. citizen, (ii) the entity has to receive an authorization from the State and (iii) the entity’s mission must comply with the United States’ international obligations.

#### *i) U.S. citizen*

Section 402 §51301 paragraph (3) defines the expression “United States citizen” by way of reference to Title 51 of the U.S. Code<sup>160</sup>. Accordingly, clause (A) and (B) give an ordinary definition of “U.S. citizens” which includes natural persons with American

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<sup>158</sup>*Ibid.*

<sup>159</sup>Laura Brown, FACT SHEET – MOON EXPRESS PAYLOAD REVIEW DETERMINATION FEDERAL AVIATION ADMINISTRATION (2016), [https://www.faa.gov/news/fact\\_sheets/news\\_story.cfm?newsId=20595](https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20595); Joanne Irene Gabrynowicz, TITLE IV OF THE 2015 U.S. COMMERCIAL SPACE LAUNCH COMPETITIVENESS ACT (2017), [hereinafter J. I. Gabrynowicz, UN COPUOS (2017)] <http://www.unoosa.org/documents/pdf/copuos/lsc/2017/symp-05.pdf>.

<sup>160</sup> See National and Commercial Space Programs, 51 U.S.C. §50902 (1996) (U.S.), <http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title51-section50902&num=0&edition=prelim> [hereinafter Title 51 U.S.C.].

citizenship and legal entities directly submitted to U.S. Law.<sup>161</sup> So far, Title IV only applies within the strict borders of the United States.

The definition of a U.S. citizen provided by clause (C) however considerably broadens the pool of entities concerned by the CSLCA. It considers that entities “organized or existing *under the laws of a foreign country*”<sup>162</sup> can, under specific circumstances, be seen as U.S. citizens.<sup>163</sup> These circumstances are that the ‘controlling interest’ of said entities is held by a U.S. citizen as defined in clauses (A) and (B), *i.e.* a natural person or legal entity directly submitted to U.S. law.<sup>164</sup> The notion of ‘controlling interest’ is thus the key-element to define the scope of application of Title IV.

The duty to determine what constitutes a ‘controlling interest’ falls on the Secretary of Transportation and is written down in the U.S. Code of Federal Regulations<sup>165</sup>. Accordingly, a ‘controlling interest’ in an entity is reflected by the “ownership of an amount of equity [...] sufficient to direct management of the entity or to void transactions entered into by management”; an interest of fifty-one percent being presumed sufficient.<sup>166</sup>

Consequently, are considered U.S. citizens in the sense of Title IV of the CSLCA: (a) a natural person with U.S. citizenship, (b) a legal entity organized and existing under the laws of the United States and (c), a foreign “corporation, partnership, joint venture,

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<sup>161</sup> Legal entities directly submitted to U.S. Law includes American companies as well as governmental and State entities

<sup>162</sup> Emphasis added.

<sup>163</sup> Title 51 U.S.C *op. cit.* n. 160.

<sup>164</sup> *Ibid.*

<sup>165</sup> See Aeronautics and Space, 14 CFR 401.5, <https://www.gpo.gov/fdsys/pkg/CFR-2011-title14-vol4/xml/CFR-2011-title14-vol4-sec401-5.xml>.

<sup>166</sup> *Ibid.*

association, or other entity”<sup>167</sup> with at least fifty-one percent of equity owned by a natural of legal American person.

This provision means that investors and partners in companies owned by at least fifty-one percent by U.S. citizens will benefit from the provision of Title IV. Let us take the example of the company Planetary Resources. It is an American company though not all funding investors are.<sup>168</sup> For instance, Richard Branson is a British citizen. But as an investor to an American asteroid mining company, Mr. Branson will benefit from the profit made by Planetary Resources thanks to the regulatory framework provided by Title IV. Therefore, the influence of Title IV of the CSLCA is not strictly limited to the United States borders.

#### ii) Governmental authorization

In addition to the citizenship requirement, space mining companies must be granted an authorization by the United States in order to legally carry out their activities in outer space.<sup>169</sup> This requirement relates to the international obligation of the United States to authorize and supervise the activities in space of their nationals, as provided by Article VI of the Outer Space Treaty.

In that sense, Title IV requires the President of the United States to submit to Congress a report determining a new authorization process since existing ones are not applicable to space mining activities.<sup>170</sup> Accordingly, on April 4, 2016, the White House’s Office

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<sup>167</sup> *Ibid.*

<sup>168</sup> See <http://www.planetaryresources.com/company/#team>.

<sup>169</sup> Title 51 U.S.C *op. cit.* n. 160, §51302(b).

<sup>170</sup> *Ibid* and J. I. Gabrynowicz, UN COPUOS (2017) *op. cit.* n. 159.



of Science and Technology Policy issued a report in response to the requirement of Title IV §51302(a).<sup>171</sup>

In its Appendix, the report expressly states that “no person that is subject to the jurisdiction or control of the United States may, directly or through any subsidiary or affiliate, conduct missions in outer space without authorization”.<sup>172</sup> Nonetheless, the Administration recommends a minimal degree of government which is coherent with Title IV statement that “government barriers”<sup>173</sup> shall be discouraging in the matter at hand. This, in its turn, should not be understood as a will to grant any space mining entity the authorization to pursue its planned mission.

In the absence of regulation, which will require a congressional act, the U.S. government resorted to use the “Federal Aviation Administration (hereinafter FAA)’s payload review process” to issue mission authorization.<sup>174</sup> This temporary solution is to be limited to the procedural aspects of mission authorization and is based on interagency cooperation.<sup>175</sup> For instance, the U.S. Department of State will be responsible to assess the compliance of the company’s proposal with the United States international obligations, such as the compliance with the provisions of the Outer Space Treaty.

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<sup>171</sup> OFFICE OF SCIENCE AND TECHNOLOGY POLICY (OSTP), REPORT ON ON-ORBIT AUTHORITY, AS REQUIRED BY THE COMMERCIAL SPACE LAUNCH COAMPETITIVENESS ACT (PUBLIC LAW 114-90) (2016), <https://www.whitehouse.gov/node/22244> [hereinafter OSTP Report].

<sup>172</sup> *Ibid.*

<sup>173</sup> Title 51 U.S.C *op. cit.* §51302(a)(2).

<sup>174</sup> OSTP Report; T. Masson-Zwaan (2017) *op. cit.* n. 124, pp. 11-12.

<sup>175</sup> J. I. Gabrynowicz, UN COPUOS (2017) *op. cit.* n. 159.

The system was tested in 2016 when Moon Express Inc., an American company, submitted a request to the FAA for a Payload Review.<sup>176</sup> While both the FAA and the Department of State agreed to deliver the company a mission authorization, it was stressed that the authorization did not extend to future missions by the company, making it clear that the current process for authorization is done on a case-by-case basis until such a time a law is passed to establish an authorization regime.<sup>177</sup>

### iii) Compliance with the United States' international obligations

Finally, the third condition is that space mining entities must comply with the international obligations of the United States. To that end, Title IV ensures that space mining missions will be reviewed by the State thus fulfilling the obligation to authorize and supervise nationals' activities in outer space.<sup>178</sup>

Title IV is particularly attentive to the prohibition, under Article II of the Outer Space Treaty, of appropriating outer space. In section 403, it provides that “it is the sense of Congress that by the enactment of this Act, the United States does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body”. In that regard, the IISL affirmed that the intent of the United States to entitle its citizens to space resources was “independent from the claim of sovereign rights over celestial bodies, which the United States explicitly does not make”.<sup>179</sup> Furthermore, we noted in section 1 that the appropriation of extracted resources was not in violation of Article II of the Outer Space Treaty.

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<sup>176</sup> Laura Brown (2016) *op. cit.* n. 159.

<sup>177</sup> *Ibid* and J. I. Gabrynowicz, UN COPUOS (2017) *op. cit.* n. 159.

<sup>178</sup> Outer Space Treaty, Article VI.

<sup>179</sup> IISL Position Paper (2015), *op. cit.* n. 128.

Lastly, the law precises that the activities carried out under Title IV of the CSLCA must be “free from harmful interference”.<sup>180</sup> This sentence clearly refers to the obligation of States Parties, under Article IX of the Outer Space Treaty, to operate in outer space “with due regard to the corresponding interests of all other States Parties to the Treaty”.

Evidently, the approach of the United States is mindful of the “international order”<sup>181</sup>. It cannot be said that the adoption of Title IV was an attempt to play on a loophole of the law. On the contrary, the establishment of this legal framework allowed implementing a national process that ensures that international laws will be respected. Without the adoption of Title IV, it is doubtful that the United States would have attempted to create an authorization process specifically design to answer the complexity of space mining activities. Although not perfect, the solution provided by Title IV is nevertheless a step in the right direction, at least until such a time the international community agrees on a better, more lasting solution.

## **B. Luxembourg**

A similar approach was adopted last July 2017 in Luxembourg. The country had announced, back in February 2016, its intention to develop “a series of measures to position Luxembourg as a European hub in the exploration and use of space

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<sup>180</sup> Title IV of the CSLCA, *op. cit.* n. 8, §51302(a)(3).

<sup>181</sup> Working paper submitted by the Russian Federation, STSC, Sess. 53rd, at 7, UN Doc A/AC.105/C.1/2016/CRP.15 (2016).

resources”.<sup>182</sup> The intention came to reality on August 1, 2017 with the entry into force of the ‘Loi sur l’exploration et l’utilisation des ressources de l’espace’.<sup>183</sup>

The new law has two primary objectives: first to establish a legal and regulatory framework which provides space mining actors with legal certainty regarding the ownership of space resources and second, to regulate the authorization and supervision process of space mining missions.<sup>184</sup>

### *1. Scope of the law*

Although the parallel with the United States’ situation is worthy of note, the orientations of the law are different. Luxembourg’s new law exclusively focuses on the commercial exploration and utilization of space resources and excludes from its scope scientific exploration of outer space<sup>185</sup>. Article 3 of the law makes it clear, when it provides that the governmental authorization shall be granted for space mining activities with a ‘commercial purpose’ only. This is further made obvious by Article 4 which determines that only companies—by opposition to individuals—can be granted a mission

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<sup>182</sup> Luxembourg to launch framework to support the future use of space resources, GOUVERNEMENT.LU (2016), <http://www.gouvernement.lu/5653386/03-space-resources>.

<sup>183</sup> *Trans.* Law on the exploration and use of outer space.

<sup>184</sup> *Projet de loi sur l’exploration et l’utilisation des ressources de l’espace*, N° 7093/00 (11 Novembre 2016) (Lux) [hereinafter *Projet de loi luxembourgeois*].

<sup>185</sup> In its opinion, following its first reading of the draft law, the Conseil d’État requested Article 2 be clarified in order to exclude from its scope scientific exploration and utilization of outer space. As a result, the adopted Article 2 now refers back to the provisions of Article 3, thus limiting the scope of the law to ‘commercial purpose’. See Conseil d’État, *Projet de loi sur l’exploration et l’utilisation des ressources de l’espace*, N°51.587, at 7 (7 Avril 2017) (Lux.) and *Loi luxembourgeoise sur l’exploration et l’utilisation des ressources de l’espace op. cit.* n. 8, Articles 2(3) and 3.

authorization. This is a notable difference with the Title IV of the CSLCA which considers first individuals with American citizenship.

Luxembourg is also not attached to the idea that companies benefiting from the framework must be owned by Luxembourgish citizens. Article 4 simply refers to two conditions for its applicability: the nature of the company and its presence on Luxembourg's territory. Accordingly, companies taking the form of a *société anonyme* or a *société en commandite par action* or a *société à responsabilité limitée*<sup>186</sup> under Luxembourgish law can be granted a mission authorization by the government. The provision also extends to European companies with a registered office in Luxembourg.

This broad approach corresponds to Luxembourg's goal to become a European hub for space mining activities. So far, two American companies, a Japanese start-up and a Germano-Luxembourgish company have opened an office in Luxembourg in order to benefit from its legal framework.<sup>187</sup>

## 2. Affirmation of the right to space resources

The attraction of Luxembourg is primarily due to clear standing regarding the permissibility of appropriating space resources. As bluntly stated in Article 1 of the law “space resources are capable of being appropriated.”

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<sup>186</sup> *Trans.* Public company limited by shares, corporate partnership limited by shares and private limited liability company. This author uses the translation provided by the government of Luxembourg. See <http://www.spaceresources.public.lu/content/dam/spaceresources/news/Translation%20Of%20The%20Draft%20Law.pdf>

<sup>187</sup> The initiative was joined by the American companies Deep Space Industries and Planetary Resources, the Japanese start-up ispace, the Germano-Luxembourgish company Blue Horizon and the European Space Agency. See <http://www.spaceresources.public.lu/en/actualites.html>.

The draft version of Article 1 was more subtle in the sense that it stated that space resources could be appropriated “in accordance with international law”.<sup>188</sup> But during the first review of the law by the Conseil d’Etat, the authority found it an unnecessary precision for two reasons: firstly, there is no existing doubts that international law prevails on domestic law and secondly, the Conseil d’Etat was of the opinion that such detail would weaken the statement.<sup>189</sup>

It is thus apparent that, for Luxembourg, the question of the appropriation of space resources is not an issue; the clarification in Article 1 of the law has less to do with affirming an opinion and more to do with providing interested parties with an unambiguous regulatory framework. Luxembourg thus operates a shift from the question of appropriation to the question of the authorization and supervision of the space mining mission. For this reason, the obligation for space mining operators to obtain a mission authorization prior starting their activity is set directly after the unique provision establishing companies’ rights over space resources.

### *3. Authorization and supervision of space mining activities*

The new law introduces a differentiation in the way authorization for space missions are granted. Luxembourg, as a matter of fact, was already an important player in the outer space activities. Before the adoption of the law for the exploration and utilization of space resources last July, Luxembourg was already authorizing and supervising missions in outer space. This was done on the basis of the 1991 Law on Electronic

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<sup>188</sup> Projet de loi luxembourgeois *op.cit.* n. 184, Article 1.

<sup>189</sup> Conseil d’État, Projet de loi sur l’exploration et l’utilisation des ressources de l’espace, N°51.587, p. 9 (7 Avril 2007) (Lux.) [hereinafter Opinion of the Conseil d’Etat].

Media<sup>190</sup>, clearly focused on satellite-related activities. But with the evolution of the space industry towards the use of outer space's minerals and water,<sup>191</sup> the country decided it had to develop a new specific authorization and supervision mechanism applicable to space mining missions in order to comply with Article VI of the Outer Space Treaty.

This mechanism is based on the provision of Article 2 providing that “no person can explore or use space resources without holding a written authorization from the minister or ministers in charge of the economy and space activities”. Operating in space without this written authorization, or contravening the provisions of the authorization, is punished by a term of imprisonment and a fine, both varying in intensity depending on the provision that has been breached.<sup>192</sup>

The law thus proceeds with detailing the regime to grant mission authorization. First of all, the mission authorization is “personal and non-assignable”.<sup>193</sup> It means that the authorization cannot allow someone other than the operator requesting it, such as an intermediary, to carry out the activity.<sup>194</sup> It is also impossible to sell it. This is understandable considering that the review process attaches as much importance to the entity carrying out the activity as it does to the activity considered itself.

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<sup>190</sup> Law on Electronic Media, (27 Juillet 1991) (Lux.) as amended on December, 17, 2010 <http://www.legilux.public.lu/leg/a/archives/2010/0241/a241.pdf>.

<sup>191</sup> Following Article 2(4), the law does not apply to orbital positions or the use of frequency bands which some considers as natural resources of outer space.

<sup>192</sup> Loi luxembourgeoise sur l'exploration et l'utilisation des ressources de l'espace *op. cit.* n. 8, Article 18.

<sup>193</sup> *Idem*, Article 5.

<sup>194</sup> *Idem*, Article 2(2).

The operator must, for instance, provide evidence of its “robust internal governance arrangements, including a clear organizational structure”.<sup>195</sup> The members of the management body must also demonstrate that they have the professional experience, skills and knowledge required for the success of the mission.<sup>196</sup> Furthermore, a risk assessment of the mission must be completed by the company and attached to the application.<sup>197</sup> Indeed, following Article 16 of the law, the operator who is granted a mission authorization is fully liable for any damage caused during the mission and the preparatory work. For this reason, Luxembourg conditions the allowance of the written authorization to the proof of financial means sufficiently consequent to cover the determined risks.<sup>198</sup>

Lastly, the law establishes that the Ministers responsible for granting the mission authorization are also responsible for its supervision.<sup>199</sup> The modalities of the supervision are not precisely defined in the law since it will have to be determined on a case-by-case basis. It is however possible to include them directly in the written document authorizing the mission.<sup>200</sup>

The efforts of Luxembourg to recreate a detailed mission authorization, and to some extent, supervision regime must be applauded. While the regime has yet to be tested, it seems to balance with efficiency the necessity of a clear regulatory framework with the flexibility required by variety of missions considered.

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<sup>195</sup> *Idem*, Article 7, IISL DoS Study on Space Resource Mining *op. cit.* n. 16, p. 24.

<sup>196</sup> *Idem*, Article 9.

<sup>197</sup> *Idem*, Article 10.

<sup>198</sup> *Ibid.*

<sup>199</sup> *Idem*, Article 15.

<sup>200</sup> *Idem*, Article 12(c).



#### 4. Acknowledgment of the limits of a national framework

However, this is not to say that Luxembourg's legal framework is the miracle solution to all problems. As pointed out by the Conseil d'Etat, there remain issues left unanswered by the law, such as the recognition by other States of property rights granted by Luxembourg over space resources.<sup>201</sup> This issue arises from the nature of the act chosen to regulate space mining activities, *i.e.* a *national* law. This issue is thus not limited to the case of Luxembourg and extends to the United States.

National laws, such as the 'Loi sur l'exploration et l'utilisation des ressources de l'espace' and its American equivalent, are only enforceable on the territory of the State which adopted it.<sup>202</sup> Hence, a company could not force another State to apply within its jurisdiction the Luxembourgish law, which includes the recognition of property rights over space resources. Furthermore, unlike property rights regarding natural resources located on a State's territory, property over space resource cannot be deemed internationally recognized since outer space is *res communis*, meaning it is beyond any State's jurisdiction.<sup>203</sup> As noted by the Conseil d'Etat in its development, it is unlikely companies will restrict themselves to carrying out their business within Luxembourg's borders, particularly if they intend to commercialize acquired space resources.<sup>204</sup>

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<sup>201</sup> Opinion of the Conseil d'État *op. cit.* n. 189, p. 6.

<sup>202</sup> See ANTHONY AUST, HANDBOOK OF INTERNATIONAL LAW 43 (2014) on the territorial jurisdiction of States.

<sup>203</sup> The situation would have been different if the property rights were recognized over natural resources located on the State's territory. Cf. GA Res. 3281(xxix), UN GAOR, 29th Sess., art. 2(1), UN Doc. A/RES/39/163 (1974): "every State has and shall freely exercise full permanent sovereignty, including possession, use and disposal, over all its wealth, natural resources and economic activities".

<sup>204</sup> Opinion of the Conseil d'État *op. cit.* n. 189, pp. 6-7.

In our opinion, the fact that Luxembourg does not have its own launching platform must also be added in this consideration. It means that to carry out their space mining activities, companies will have to turn to other countries, at least, for the launching stage of the mission. As a result, such companies will have to obtain a launch license from the launching State<sup>205</sup>. Now, these licenses are often subjected to strict regulations. For instance, in France, the procurement of a launch license is conditioned to the compliance of the intended activity with French policy and its international obligations.<sup>206</sup> Therefore, it is doubtful that States which consider space mining activities contrary to the Outer Space Treaty will authorized the launch.

This situation explains why Luxembourg continues to push for the adoption, at the UN level, of an international agreement;<sup>207</sup> once all States recognize space mining complies with the principles of international norms regarding outer space, including the non-appropriation principle, the question of the recognition of property rights will become irrelevant. Interestingly enough, the attitude of Luxembourg evidences that there is no

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<sup>205</sup> Meaning the State from whose territory or facility the space object is to be launched. See. Liability Convention *op. cit.* n. 11, Article I.

<sup>206</sup> Loi Relative aux Opérations Spatiales, No. 2008-518, art. 4 (3 Juin 2008) (Fr.). Following Article VI and VII of the Outer Space Treaty and Articles I to III of the Liability Convention, launching States, here France, are responsible and liable for any damaged cause by the space object launched from their territory or facility. It is thus in their interest to control the considered activity does not violate their national law and international obligations.

<sup>207</sup> Chambre des Député, Motion : Continuation des négociations au niveau international afin d'adopter un cadre normatif multilatéral et résultant idéalement dans une adaptation du Traité sur l'Espace de 1967 (13 Juillet 2017) (Lux.) [hereinafter Motion: Continuation des négociations au niveau international afin d'adopter un cadre normatif multilatéral et résultant idéalement dans une adaptation du Traité sur l'Espace de 1967] <http://www.chd.lu/wps/portal/public/Accueil/TravailALaChambre/Recherche/RoleDesAffaires?action=doDocpaDetails&backto=/wps/portal/public/Accueil/Actualite&id=7093>; Chambre des Députés, Rapport de la Commission de l'Économie sur le Projet de loi sur l'exploration et l'utilisation des ressources de l'espace, p. 3 (6 Juillet 2017) (Lux.).

necessary opposition between the promotion of a national regulatory framework and the engagement for an international agreement on space resources.

This active engagement at the international level also indicates that the establishment of a coherent international framework for the exploitation of space resources will require more than the sole acknowledgement of the intended activities' conformity with international space law. That much is shown by the efforts invested by the United States and Luxembourg in developing legal frameworks that offers concrete measures, be it on property rights or mission authorization processes, to companies.

So far, emphasis has been put on the economic aspect of space mining. Other crucial aspects must be considered though. It has been repeatedly said that great benefits would come from engaging in the use of space resources: access to an unlimited number of resources now scarce on Earth, recycling of satellite made possible by the development of fueling stations, greater autonomy in space with the production of water and oxygen. But all those benefits rely on the long-term sustainability of outer space activities which presumes the preservation of outer space's environment for future generations.<sup>208</sup> In outer space just like on Earth, sustainable development results from the balance of the economic development with the protection of the environment.<sup>209</sup> If the 'economic development' aspect is being taken care of by Luxembourg and the United States, the

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<sup>208</sup> Long-term sustainability of outer space activities, UNOOSA, <http://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability-of-outer-space-activities.html>.

<sup>209</sup> Pursuant to Article III of the Outer Space Treaty *op. cit.*, norms of international law and by extension of international environmental law, applies to outer space. See on the notion of 'sustainable development' *Gabčíkovo-Nagymaros (Hungary/Slovakia) (Judgement)*, 1997 I.C.J. 7, 140 (Sept. 25) [hereinafter *Gabčíkovo-Nagymaros*]; A. B. M Marong, *From Rio to Johannesburg: Reflections on the Role of International Legal Norms in Sustainable Development*, 16 GEORGETOWN INTERNATIONAL ENVIRONMENTAL LAW REVIEW. 31-33 (2004).

‘environmental protection’ of outer space activities is not. It is fair to mention, however, that the motion passed by Luxembourg to promote an international agreement does refer to it.<sup>210</sup> Obviously, the protection of outer space’s environment will only be ensured if organized at the international level, as it is currently being done for Earth.<sup>211</sup> Hence it is of interest to consider international regimes of environment protection and their applicability to outer space.

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<sup>210</sup> Motion: Continuation des négociations au niveau international afin d’adopter un cadre normatif multilatéral et résultant idéalement dans une adaptation du Traité sur l’Espace de 1967 *op. cit.* n. 207.

<sup>211</sup> See [http://unfccc.int/paris\\_agreement/items/9485.php](http://unfccc.int/paris_agreement/items/9485.php).

### Section 3. Legal models promoting sustainable exploitation of natural resources at the international level

There are parallels between issues raised by space mining and concerns already addressed by the international community with regards to other aspects of *res communis*: namely Antarctica, the High Seas and Deep Seabed.<sup>212</sup> In each case, the community has reached an agreement relating to the exploitation of their natural resources.

Evidently, a *sui generis* legal framework (C) will need to be considered since the regimes of the High Seas (A) and Deep Seabed (B) are specific to the area they regulate and cannot be transposed as such to outer space.<sup>213</sup> Nonetheless, they remain of interest as they provide legitimate models to regulate the exploitation of natural resources in the *res communis* at the international level.

#### A. High Seas

Like outer space, international waters—also labelled high seas—are free to be used and accessed by all States. The concept of the freedom of use of oceans was first developed as early as 1609 by Dutch jurist and philosopher Hugo Grotius. In *Mare Liberum*,<sup>214</sup> the “father of international law”<sup>215</sup> argues that oceans belong to no State and that claims of

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<sup>212</sup> See The Antarctic Treaty, *entered into force* Jun. 23, 1961, 402 U.N.T.S. 71 and the Protocol on Environmental Protection to the Antarctic Treaty, Oct. 4, 1991, 30 ILM 1455 (1991); United Nations Convention on the Law of the Sea, *entered into force* Nov. 16 1994, 1833 U.N.T.S. 3 [hereinafter UNCLOS].

<sup>213</sup> Since there is currently a moratorium until 2048 on the commercial exploitation of Antarctica’s resources, this thesis will not consider this regime for space mining activities.

<sup>214</sup> HUGO GROTIUS, *MARE LIBERUM* (1609).

<sup>215</sup> See [http://www.judicialmonitor.org/archive\\_1007/leadingfigures.html](http://www.judicialmonitor.org/archive_1007/leadingfigures.html).

sovereignty over the area are void.<sup>216</sup> Although considered a part of customary international law, these principles were codified in 1958 in a treaty<sup>217</sup> which has since been replaced by the 1982 United Nations Convention on the Law of the Sea<sup>218</sup> (hereinafter UNCLOS).<sup>219</sup>

### *1. Owning the fish, not the sea*

The Convention lays down the rights and obligations of States as well as divides oceans in four areas where States enjoy different degrees of jurisdiction.<sup>220</sup> Part VII, titled ‘High Seas’ provides in particular that “all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State”<sup>221</sup> are open to all States for, *inter alia*, navigation and fishing, despite being beyond any national jurisdiction.<sup>222</sup>

Consequently, despite the high seas being *res communis*, their resources are susceptible of appropriation by State and their nationals.<sup>223</sup> Analyzing the high seas regime from the perspective of property rights, Sprankling affirms that wild fish cannot be owned

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<sup>216</sup> Hedley Bull, *The Law of the Sea*, in *THE ANARCHICAL SOCIETY: A STUDY OF ORDER IN WORLD POLITICS* 306 (4 ed. 2012).

<sup>217</sup> Convention on the High Seas, *entered into force* Sept. 30, 1962, 13 U.S.T. 2312, 450 U.N.T.S. 11.

<sup>218</sup> UNCLOS.

<sup>219</sup> S. Hobe (2009) *op. cit.* n. 2, p. 28.

<sup>220</sup> Namely the coastal State, the exclusive economic zone, the high seas and the deep seabed which the Convention refers to as “the Area”, see UNCLOS and JOHN G. SPRANKLING, *THE INTERNATIONAL LAW OF PROPERTY* 154 (2014) [hereinafter Sprankling].

<sup>221</sup> UNCLOS, Article 86.

<sup>222</sup> UNCLOS, Article 87 and 89, also see Sprankling *op. cit.* n. 220, p. 154.

<sup>223</sup> *Idem*, pp. 150 and 157.

because “ownership arises only when a fisher successfully takes physical possession of particular fish” <sup>224</sup> *i.e.* when the fish is caught. <sup>225</sup> Transposed to outer space, Sprankling’s approach confirms the interpretation that a distinction should be drawn between *in situ* space resources and extracted minerals, the latter being susceptible of appropriation despite being located in the *res communis*.<sup>226</sup>

## 2. Protection and preservation of the marine environment

The appropriation of living resources in the high seas is not, however, without limits. The UNCLOS imposes upon States duties relating to the preservation and protection of the marine environment.<sup>227</sup> Following Article 117 of the Convention, States must implement national measures to prevent the “unsustainable exploitation of oceans fisheries”<sup>228</sup> by their nationals. The UNCLOS pays particular attention to cases where “identical living resources” or “different living resources [but located] in the same area” are exploited by nationals of different States.<sup>229</sup> In this instance, States are required to cooperate with one another to establish appropriate “subregional or regional fisheries organizations”.<sup>230</sup>

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<sup>224</sup> *Ibid.* Also see M. J Peterson, *Exploring and Using the Moon*, in INTERNATIONAL REGIMES FOR THE FINAL FRONTIER. 155 (2005).

<sup>225</sup> *Idem*, pp. 157-158.

<sup>226</sup> *Supra*, p. 32.

<sup>227</sup> UNCLOS, Articles 117-119.

<sup>228</sup> Sprankling *op. cit.* n. 220, p. 157.

<sup>229</sup> UNCLOS, Article 118.

<sup>230</sup> *Ibid.*

States are also trusted with “determining the allowable catch” to “maintain or restore populations of harvested species”.<sup>231</sup> Article 119 of the UNCLOS is particularly detailed on this point, providing that States shall base their estimate on “scientific evidence” and consider the “fishing patterns, the interdependence of stocks” and the “effects [of exploitation] on species associated with or dependent upon harvested species”. The UNCLOS also encourages States to share through “competent international organization” their statistics and other data relevant for the conservation of fishing stocks “on a regular basis” for a better management of marine living resources at the regional and global level.<sup>232</sup>

Lastly, the UNCLOS addresses the issue of protecting the marine environment in its entirety by requesting States take measures to prevent the ‘pollution of the marine environment’.<sup>233</sup> The Convention adopts a broad understanding of the expression and considers as an act of polluting: “the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities”<sup>234</sup>. States must thus take measures to avoid, in particular, releasing “toxic,

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<sup>231</sup> *Idem*, Article 119.

<sup>232</sup> *Ibid.*

<sup>233</sup> *Idem*, Article 194.

<sup>234</sup> *Idem*, Article 1(c).



harmful or noxious substances” in the ocean and control “pollution from vessels” and other “installations and devices operating in the marine environment”.<sup>235</sup>

The freedom to use the oceans and their resources is thus far from being unlimited under the 1982 UNCLOS regime. The Convention explicitly acknowledges the environmental dimension of exploitation activities and works to balance the protection of the marine environment with the freedoms granted upon States and their nationals in order for them to “produce the maximum sustainable yield”.<sup>236</sup> Eventually, this regime provides precise ways to articulate a regime of ownership and *res communis*, makes room to address environmental concerns, while promoting reasonable uses of resources: hence its interest when similar issues are dealt with in outer space. The question, however, is whether it is transposable, precisely, to outer space.

### *3. Applicability of the ‘high seas’ regime to outer space*

Despite the merits of the High Seas regime’ approach to property rights over resources located in the *res communis*, the difference between the oceans and outer space on one hand, and between sea resources and space resources on the other hand is too great to allow a transposition of the regime to outer space.

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<sup>235</sup> *Idem*, Article 194, also see MC Baker, THE STATUS OF NATURAL RESOURCES ON THE HIGH-SEAS (2001), [https://www.google.lu/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwiXj\\_\\_hp4XWAhXI6oMKHbdMAJAQFggmMAA&url=https%3A%2F%2Fcmsdata.iucn.org%2Fdownloads%2Fhighseas.pdf&usg=AFQjCNEsorTuY37C4F7bPXs4OLvUn-PvFw](https://www.google.lu/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwiXj__hp4XWAhXI6oMKHbdMAJAQFggmMAA&url=https%3A%2F%2Fcmsdata.iucn.org%2Fdownloads%2Fhighseas.pdf&usg=AFQjCNEsorTuY37C4F7bPXs4OLvUn-PvFw).

<sup>236</sup> UNCLOS, Article 119.

Firstly, the vast nature of outer space compared to the “digestible size”<sup>237</sup> of the oceans on Earth renders impossible the estimation of the “stock” of asteroids. Yet, quantifying the amount of resources existing and consumed is pillar of the UNCLOS’ regime to protect and preserve the marine environment.

Secondly, the very essence of living resources is that they reproduce. They are renewable resources; asteroids are not.<sup>238</sup> Although some consider asteroids an unlimited resource due to the infinity of outer space,<sup>239</sup> the amount of asteroids reachable is not. Current estimates counts that our solar system holds no more than an estimate of two million asteroids of sizable interest.<sup>240</sup> Once harvested, space resources will be gone forever. It will thus be impossible to wait for the resource to be ‘restored’<sup>241</sup>, which is central in the High Sea regime.

Therefore, when considering the environmental impact of space mining activities, the future international regime will need to adapt to the specificities of space resources, namely their non-renewable nature. In this context, it becomes opportune to analyze the Deep Seabed regime—also regulated by the UNCLOS—since it relates to the exploitation of minerals in the *res communis*.

## **B. Deep Seabed**

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<sup>237</sup> PHILIP DE MAN, EXCLUSIVE USE IN AN INCLUSIVE ENVIRONMENT: THE MEANING OF THE NON-APPROPRIATION PRINCIPLE FOR SPACE RESOURCE EXPLOITATION 8 (2016).

<sup>238</sup> IISL DoS Study on Space Resource Mining *op. cit.* n. 16, p. 32.

<sup>239</sup> K. MacWhorter *op. cit.* n. 4, p. 652.

<sup>240</sup> *Ibid.* here we refer to asteroids of a kilometer or more in diameter.

<sup>241</sup> UNCLOS, Article 119.

Similarly to the high seas and outer space, the “Area”<sup>242</sup> or deep seabed—which includes “the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction”<sup>243</sup>—is open to use by all States.<sup>244</sup> A notable difference however is the express reference in Article 136 of the UNCLOS to the “Area and its resources [being] the common heritage of mankind”. This is not without echoing the ‘common heritage’ principle of Article 11 paragraph 1 of the 1979 Moon Agreement. The parallel might as well be a *caveat*: it must be reminded that this principle was one of the major reasons for the poor ratification of the treaty.<sup>245</sup> Nevertheless, there might be enough difference between the principle laid down in the UNCLOS and the one stated by the Moon Agreement to avoid major objections by potential parties.<sup>246</sup>

#### *1. Property rights over extracted resources located in the res communis*

Unlike the Moon Agreement, even though the ‘common heritage’ principle in the UNCLOS forbids States to claim sovereignty rights over the deep seabed area and its resources, it does not, paradoxically, preclude the exploitation by States and their nationals of said resources.<sup>247</sup> Pursuant to Article 137 paragraph 2 of the Convention, the rights over the resources of the deep seabed are vested by the International Seabed Authority (hereinafter ISA) on behalf of “mankind as a whole”. Resources are thus not appropriable directly by States; States Parties to the UNCLOS having to be authorized

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<sup>242</sup> The UNCLOS refers to the deep seabed as ‘the Area’, see Article 1 and Part XI of the UNCLOS.

<sup>243</sup> *Idem*, Article 1(a).

<sup>244</sup> *Idem*, Article 141.

<sup>245</sup> *Supra*, p. 17.

<sup>246</sup> F. Tronchetti et al. (2013) *op. cit.* n. 60, p. 394-395.

<sup>247</sup> UNCLOS, Article 137.

by ISA prior to start exploiting the Area.<sup>248</sup> Therefore the regime governing the use of the deep seabed's minerals is entirely organized around the ISA, as its role is to "organize, carry out and control"<sup>249</sup> all activities in the seabed.

### *3. The structure of the International Seabed Authority*

The Authority, established in Jamaica, is constituted *ipso facto* of all States Parties to the Convention and divided into four bodies: the Assembly, the Council, the Secretariat and the Enterprise.

#### *a. The Assembly*

The Assembly is the supreme organ of ISA. It is constituted of all States Parties and is in charge of developing general policies for the exploration and exploitation of the deep seabed.<sup>250</sup> It is also competent to determine the best mechanisms for the "equitable sharing of financial benefits and other economic benefits derived from activities" in the Area.<sup>251</sup>

Indeed, pursuant to Article 8 of Annex III, applicants applying to ISA for a license to explore and exploit the seabed must reserve half of the considered area for ISA to use.<sup>252</sup> Since ISA acts on behalf of 'mankind as a whole',<sup>253</sup> it means that developing countries that do not have the financial or technological means to exploit deep seabed will benefit from the activity. Particularly so, considering that the 'reserved area' can

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<sup>248</sup> UNCLOS, Annex III, Article 3.

<sup>249</sup> *Idem*, Article 153.

<sup>250</sup> *Idem*, Articles 159 and 160.

<sup>251</sup> *Ibid* and Article 140.

<sup>252</sup> *Idem*, Annex III, Article 8.

<sup>253</sup> *Idem*, Article 137.

only be exploited by ISA or by developing countries and entities they sponsor.<sup>254</sup> Furthermore, Annex III ensures that the ‘reserved area’ is of equal commercial value as the one exploited by the Applicant, thus ensuring an equitable sharing of the benefits.

b. the Council

The Council works as the executive organ of ISA and is constituted of thirty-six members elected by the Assembly.<sup>255</sup> Its role is, *inter alia*, to implement the provisions of the UNCLOS relating to the Area and to establish, when needed, subsidiary organs to further assist in its functions.<sup>256</sup> The Council also elects fifteen members for each of its commissions, namely the Economic Planning Commission and the Legal and Technical Commission.<sup>257</sup>

The Economic Planning Commission is responsible for everything linked with the supply, demand and price of mineral extracted in the seabed;<sup>258</sup> the Legal and Technical Commission is responsible for environmental issues relating to the activities carried out in the Area.<sup>259</sup> Its prerogatives include the completion of environmental impact assessments for planned missions, the supervision of said missions to ensure they do not negatively affect the marine environment, as well as making recommendations to the Council with regard to its environmental policy.<sup>260</sup> In other words, each Commission under the Council focuses on one of the two elements pertaining to the question of

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<sup>254</sup> *Idem*, Annex III, Article 8.

<sup>255</sup> *Idem*, Articles 161 and 162.

<sup>256</sup> *Idem*, Article 162.

<sup>257</sup> *Idem*, Article 163.

<sup>258</sup> *Idem*, Article 164.

<sup>259</sup> *Idem*, Article 165.

<sup>260</sup> *Ibid.*

sustainable development:<sup>261</sup> the economic development of the world through the use of the resources the deep seabed has to offer, and the protection of the environment.

c. the Secretariat

The Secretariat is the administrative organ of ISA and is in charge of making arrangements “for consultation and cooperation with international and non-governmental organizations”.<sup>262</sup> The Secretariat is composed of the Secretary-General and its staff; the Secretary-General acting as the “chief administrator of the Authority”. She or he is elected for a renewable four years mandate.<sup>263</sup>

d. the Enterprise

Finally, the Enterprise is the acting organ of ISA. It is in charge of carrying out directly ISA’s activities such as the exploitation of ‘reserved areas’, a mission which includes the transportation, processing and marketing of recovered minerals.<sup>264</sup>

*3. Regulating activities in the deep seabed*

a. Prospecting, exploration and exploitation of deep seabed mineral resources

Pursuant to the UNCLOS, three types of activities can be carried out in the deep seabed: prospecting, exploration and exploitation.<sup>265</sup> Despite their similarity, namely searching

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<sup>261</sup> Gabčíkovo-Nagymaros, *op. cit.* n. 209.

<sup>262</sup> UNCLOS, Articles 166 and 169.

<sup>263</sup> *Ibid.*

<sup>264</sup> *Idem*, Article 170.

<sup>265</sup> *Idem*, Annex III.

for minerals deposits, the Convention distinguishes between ‘prospecting’ and ‘exploring’ the Area.<sup>266</sup> This distinction between the two relates to exclusive rights.

In this context, a prospecting entity will search for mineral deposits with no exclusive rights, the area being potentially searched “simultaneously by more than one prospector”.<sup>267</sup> For this reason, ISA does not require prospectors to obtain a ‘prospecting license’ and simply imposes a duty to notify the Secretary-General about the geographical limits of the area prospected.<sup>268</sup> Furthermore, entities that intend to “explore” the seabed with exclusive rights in order to assess the deposits’ commercial value must apply to ISA for a license; whether this license covers future exploitation remains the choice of the Applicant.<sup>269</sup> Therefore, the UNCLOS develops an international licensing regime, under the control of ISA, to regulate activities in the deep seabed.

#### b. Licensing system

Pursuant to Article 153 paragraph 3 of the UNCLOS, “activities in the Area shall be carried out in accordance with a formal written plan of work”. This plan must specify, *inter alia*, the geographical zone considered for activities, its size and the duration of the operation.<sup>270</sup> The applicant, namely a State Party, a State enterprise sponsored by a State

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<sup>266</sup> *Idem*, Annex III, Articles 2 and 3.

<sup>267</sup> *Idem*, Annex III, Article 2.

<sup>268</sup> *Ibid.*

<sup>269</sup> *Idem*, Annex III, Article 3; also see Michael W. Lodge, THE REGULATORY REGIME FOR DEEP SEABED MINING (2011), <https://www.isa.org.jm/files/documents/EN/Seminars/2011/RegulatoryRegime-MLodge.pdf>.

<sup>270</sup> UNCLOS, Annex III, Article 17.

Party or a national of a State Party over which said State has effective control,<sup>271</sup> must also agree to comply with the all the provisions of the UNCLOS relating to the deep seabed and the protection of the marine environment, and recognize the authority of ISA's decision.<sup>272</sup> The plan of work will then be reviewed by the Legal and Technical Commission and, if approved by the Council, shall take the form of a contract between the applicant and ISA.<sup>273</sup>

Contracting directly with ISA presents the advantage of contracting with the international community since the Authority acts on behalf of mankind as a whole. Consequently, every right granted to the applicant on the contractual basis will be recognized by all States Parties to the UNCLOS.<sup>274</sup> For instance, Article 1 of Annex III provides that "Title to minerals shall pass upon recovery in accordance with this Convention". The licensing system developed in the UNCLOS thus removes issues related to the recognition by other States of property rights in mineral extracted.<sup>275</sup>

Finally, the contractual form of the arrangement forces operators to effectively consider the marine environment. Since the agreement of the Council to issue a license for exploration and/or exploitation is dependent of the applicant's engagement to respect

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<sup>271</sup> *Idem*, Annex III, Article 5.

<sup>272</sup> *Idem*, Annex III, Article 17.

<sup>273</sup> *Idem*, Annex III, Article 3 (5).

<sup>274</sup> To date, 168 States are party to the UNCLOS, see [https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg\\_no=XXI-6&chapter=21&Temp=mtdsg3&lang=en#1](https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&lang=en#1).

<sup>275</sup> Sprankling, *op. cit.* n. 220, p.164.



the “rules, regulations and procedures of the Authority”<sup>276</sup>, the exploiting party is contractually obliged to avoid wasting resources and polluting the environment.<sup>277</sup>

The Deep Seabed regime thus presents a valid alternative to the High Sea regime to govern the exploitation of non-living resources. The establishment of an international regime to overview the exploitation of the resources in an international area has the merits of facilitating the recognition of property rights at the international level while having enough control over the operators to exercise an effective management of non-renewable resources and equitable share of the benefits between countries.<sup>278</sup>

#### *4. Financial concerns of starting and maintaining an international organization*

The legal model of ISA cannot be properly assessed without considering the financial aspects of creating and maintaining an international organization. The financing of ISA was the object of many discussions by the international community which resulted in the adoption, in 1994, of the Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982<sup>279</sup>. Many States considered that the structure of ISA was too elaborate; particularly considering that, at the time, mining the deep seabed was not yet technologically possible.<sup>280</sup>

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<sup>276</sup> UNCLOS, Annex III, Article 3.

<sup>277</sup> UNCLOS, Articles 150 and 194, also see S. Coffey (2009) *op. cit.* n. 4, pp. 134-136.

<sup>278</sup> *Ibid.*

<sup>279</sup> Res. 48/263, UN GA, 48<sup>th</sup> Sess., UN Doc. A/RES/48/263 (1994) [hereinafter 1994 Agreement].

<sup>280</sup> Information Note concerning the Secretary-General’s informal consultation on outstanding issues relating to the deep sea-bed mining provisions of the UN Convention on the Law of the Sea, 14-16 (1991), [hereinafter Information Note (1991)]  
<https://www.google.lu/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjy6zakYfWAhVH6IMKHbGUA5UQFgggMAE&url=https%3A>

Maintaining an international body means that States Parties will have to finance operational costs, maintenance of staff and of the headquarters as well as the servicing of meetings of the various bodies, namely for ISA, the Assembly, Secretariat, Commissions and Council, as well as the Enterprise.<sup>281</sup> For this reason, the international community decided to adopt the evolutionary approach of a “cost-effective” structure.<sup>282</sup> It means that instead of organizing the structure of ISA in function of what *in fine* will be done, it is to be structured with regards to the present needs. For instance, instead of deciding that the Assembly will meet, say three times a year, the Assembly will meet only when strictly necessary in order to limit servicing costs.<sup>283</sup> This also means that subsidiary bodies will be created only if strictly necessary and that meetings will be organized when needed rather than instituting a quota of meeting per period.

##### *5. Applicability of the Deep Seabed regime to outer space*

The hesitance of the international community to finance an international community specifically to regulate the exploitation of resources in the deep seabed raises the question of the opportunity of creating a similar organization to control space mining activities. The concerns regarding the costs of mining the deep seabed can easily be transposed to carrying out activities in outer space. As noted before, space activities are expensive. Coffey argues that few States are currently able to access outer space on their own, be it for lack of financial means or technology and that it is thus unlikely that

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[www.isa.org.jm/files/documents/FEN/FPubs/FSG-  
InformConsultations-ae.pdf&usg=AFQjCNH2frhlbb\\_csoJ9NOkrALj4\\_IXeog](http://www.isa.org.jm/files/documents/FEN/FPubs/FSG-<br/>InformConsultations-ae.pdf&usg=AFQjCNH2frhlbb_csoJ9NOkrALj4_IXeog).

<sup>281</sup> *Ibid.*

<sup>282</sup> 1994 Agreement *op. cit.*, Annex, Section 1 paragraph 2 and L. D. M. Nelson, *The New Deep Sea-Bed Mining Regime*, 10 THE INTERNATIONAL JOURNAL OF MARINE AND COASTAL LAW 196 (1995).

<sup>283</sup> Information Note (1991) *op. cit.* n. 280, p. 16.

said countries will be interested in investing money in an activity that does not directly benefit them.<sup>284</sup>

Therefore, in our opinion, a compromise should be reached between creating a fully international organization and leaving States to regulate space mining activities on their own. An alternative could be to build upon the provision of Article XI of the Outer Space Treaty which provides that “States Parties to the Treaty conducting activities in outer space, including the Moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities” and leaves to the UN Secretary-General the duty to disseminate the information to the public. Similarly, States could be required to provide the UN Secretary-General with detailed information about the mission envisaged. Such information would include, *inter alia*, the location and size of the mining site, the duration of the activity, its purpose as well as the measures taken by the operator to avoid polluting outer space. These information should also be publicly accessible, for instance via the UNOOSA’s website as it is done for registered space objects, to ensure transparency and compliance of the operator with international space law.

### **C. For a *sui generis* legal framework**

Such a system would be sufficient in itself inasmuch it would give an overview of the intensity of space mining activities. However, the future international regime, as noted before, will need to do more, namely seriously consider the protection of the outer space

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<sup>284</sup> S. Coffey *op. cit.* n. 4, p. 135.

environment, starting with the rational management of space resources, as suggested by Article 11 paragraph 7(b) of the Moon Agreement.

### *1. Credit system*

To that end, authors have considered adapting to resource extraction the credit system developed in the Montreal Protocol on Substances that Deplete the Ozone Layer<sup>285</sup> and more recently in the Kyoto Protocol<sup>286</sup> to the United Nations Framework Convention on Climate Change (hereinafter Kyoto Protocol) in order to reduce global emission of CO<sub>2</sub>.<sup>287</sup> This credit system works as such: States Parties are allocated a certain amount of emission quota per time period. If a State needs more credits, it can buy it from another State; thus keeping global emission levels balanced.<sup>288</sup>

Even though Paxson primarily envisages this approach in the context of benefit sharing, a credit system would also be beneficial to the outer space environment and the management of its resources. Paxson explains that, pursuant to the adoption of a credit system, “each country would be allocated a certain amount of lunar mining credits, which would allow the holder of the credits to engage in mining certain tonnage of natural resources on the Moon for a given period”.<sup>289</sup> From the environmental standpoint, it would ensure that space resources are not excessively consumed without imposing burdensome limits on space actors. Similarly to the Kyoto Protocol, space-

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<sup>285</sup> Montreal Protocol on Substances that Deplete the Ozone Layer *entered into force* Jan. 1, 1989, 1522 U.N.T.S. 3, 26 I.L.M. 1550.

<sup>286</sup> Kyoto Protocol to the United Nations Framework Convention on Climate Change *entered into force* Feb. 16, 2005, 37 I.L.M. 22.

<sup>287</sup> United Nations Framework Convention on Climate Change *entered into force* March, 21, 1994, art. 2, 1771 U.N.T.S. 107, 31 I.L.M. 849.

<sup>288</sup> S. Coffey (2009) *op. cit.* n. 4, p. 137.

<sup>289</sup> W. Paxson (1992) *op. cit.* n. 25, pp.514.

faring nations would be able to buy more credits from non-space-faring nations should the need arise, thus answering their material needs without overexploiting outer space.<sup>290</sup> The system would also allow developing countries to “reap financial rewards from space exploration” without needed to access outer space.<sup>291</sup>

However, the system is not without its problems. Coffey rightfully points out that the adoption of credit system first raises the issue of the criterion to allocate credits.<sup>292</sup> Should the repartition of credits be based on population and should developing countries be given additional credits to compensate the fact they cannot directly benefit from space? <sup>293</sup> While the question may not be limited to outer space activities, it is easier to come to an agreement when everyone moves towards a common goal. This might prove the main difficulty. With the adoption of the Kyoto Protocol, States Parties intended to prevent climate change, a problem that concerns every country; with outer space however, the goal differs from one group to the other. Space-faring nations are interested in being able to use space resources while non-space-faring nations want reassurance they will benefit from the development of space mining activities. The international community will thus need to find a compromise and determine guidelines for the allocation of credits. From there, the allocation of credits to space operators and supervision of their activities should be organized at the national level by each State.<sup>294</sup> Consequently, the adoption of a credit system would be less expensive than starting an international organization like ISA.

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<sup>290</sup> *Ibid.*

<sup>291</sup> *Idem*, p. 515.

<sup>292</sup> S. Coffey (2009) *op. cit.* n. 4, p. 138.

<sup>293</sup> *Ibid.*

<sup>294</sup> W. Paxson (1992) *op. cit.* n. 25, pp.514.

The reference by Paxson to “lunar resources” however must be stressed. Indeed, contrary to the Moon, asteroids exist in a vast number and all differ from one another. For this reason, and as previously noted in (A), it would be close to impossible to assess asteroid resources on a whole.<sup>295</sup> Nonetheless, a credit system would still greatly benefit the Moon, the resources of which are clearly limited. As such, the preservation of the Moon should be a priority of the future international framework.

## *2. Preserving the Moon*

The preservation of an environment with the regards to the exploitation of its natural resources does not only depend on the number of resources extracted. As demonstrated by the UNCLOS, preserving an area also require considering the interdependency between resources.<sup>296</sup> Evidently, the UNCLOS refers to the food chain but in the context of lunar exploitation, one must consider the interdependence between Earth and the Moon. It is an established fact that the Moon affects oceans tides and contributes to the stabilization of Earth’s axis of rotation, a key-element to the development of life on the planet.<sup>297</sup>

As the effect of mining remains unknown at the time, the international community must be cautious and consider the danger of over-exploiting Earth’s only natural satellite. Therefore, in addition to the credit system, we would suggest adopting a “space resources for outer space only” policy with regard to lunar exploitation. As such, lunar resources would be solely used to develop a space economy in outer space, for instance

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<sup>295</sup> K. MacWhorter (2016) *op. cit.* n. 4, p. 671.

<sup>296</sup> UNCLOS, Article 119.

<sup>297</sup> See <https://lunarexploration.esa.int/#/explore/science/225?oa=257>.

processing ice into drinkable water or breathable oxygen for astronauts.<sup>298</sup> The adoption of this policy should not however preclude States from removing and bringing back to Earth Moon samples for scientific purposes.<sup>299</sup>

### *3. Preventing the pollution of outer space*

Lastly, the vast number of asteroids present in our solar system should not be a justification for careless exploitation of their resources. Even though the risk of overexploiting asteroids resources is not a main concern at the time, it must be highlighted that any mining activity is bound to contaminate outer space's pristine environment.<sup>300</sup> With regard to asteroids, their exploitation is bound to release in the atmosphere particles which could be assimilated to space debris.<sup>301</sup> This is particularly problematic considering that "even the tiniest debris particle circulating in outer space [...] is travelling about 17 times faster than a machine gun bullet"<sup>302</sup>. Asteroid dust would thus have the potential to damage satellites.<sup>303</sup>

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<sup>298</sup> See

[http://www.esa.int/About\\_Us/Business\\_with\\_ESA/Business\\_Opportunities/Water\\_and\\_oxygen\\_made\\_on\\_the\\_Moon](http://www.esa.int/About_Us/Business_with_ESA/Business_Opportunities/Water_and_oxygen_made_on_the_Moon).

<sup>299</sup> In that sense, see Moon Agreement, Article 6.

<sup>300</sup> Francis Lyall, *Planetary Protection from a Legal Perspective - General Issues*, in IAA COSMIC STUDY 'PROTECTING THE ENVIRONMENT OF CELESTIAL BODIES' 55–63 (Mahulena Hofmann, Petra Rettberg, & Mark Williamson eds., 2010); M. B. Duke, W. W. Mendell & P. W. Keaton, Report of the Lunar Base Working Group 9 (1984).

<sup>301</sup> The expression 'space debris' is commonly accepted as referring to "all tangible man-made materials in space other than functional space objects", see LOTTA VIKARI, *THE ENVIRONMENTAL ELEMENT IN SPACE LAW ASSESSING THE PRESENT AND CHARTING THE FUTURE* 31 (2008).

<sup>302</sup> *Idem*, p. 37.

<sup>303</sup> Sarah Scoles, DUST FROM ASTEROID MINING SPELLS DANGER FOR SATELLITES NEW SCIENTIST (2015), <https://www.newscientist.com/article/mg22630235-100-dust-from-asteroid-mining-spells-danger-for-satellites/>.

In addition, space mining activities will introduce foreign chemicals in the environment of mined celestial bodies; it is a fact that mining activities at best drastically change the surface of exploited celestial bodies.<sup>304</sup> Space mining thus raises, as it does for other space activities, the issue of planetary protection. This issue was already addressed in 1967 by the international community from a legal standpoint. Indeed, Article IX of the Outer Space Treaty provides against the harmful contamination of outer space, including the Moon and other celestial bodies such as asteroids. In practice, the establishment of protective measures is left to the Committee on Space Research (hereinafter COSPAR), an international scientific group. To date, COSPAR has defined five categories of space missions, each of which are being accompanied by recommendatory measures. For instance, Category V deals in particular with Earth-return missions and establishes measures to avoid the contamination of the “terrestrial system” *i.e.* of the Earth and the Moon.<sup>305</sup> Among the recommendations for Category V missions, COSPAR calls for the “containment of any unsterilized sample collected and returned to Earth”.<sup>306</sup> Consequently, there exist already measures in place to protect, to some extent, outer space environment; however it is doubtful that these measures are sufficient to enforce planetary protection with regards to space mining activities.

For these reasons, in parallel to the work of COSPAR, the future international regime shall encourage States to conduct environmental impact assessments prior to the start of

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<sup>304</sup> International Academy of Astronautics Cosmic Study “Protecting the Environment of Celestial Bodies,” 29, 43 (Petra Rettberg, Mahulena Hofmann, & Mark Williamson eds., 2010).

<sup>305</sup> A. Debus, *Planetary Protection: Organisation, Requirements and Needs for Future Planetary Exploration Missions*, 543 106 (2004), <http://adsabs.harvard.edu/abs/2004ESASP.543..103D>.

<sup>306</sup> *Ibid.*



each mining mission, as it is done by ISA for exploration and exploitation regimes,<sup>307</sup> in order to prevent, to the best of their capacity, polluting outer space.

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<sup>307</sup> UNCLOS, Article 165.

## Conclusion

From the beginning, space mining has been marked by the considerable involvement of the private sector in pushing towards a space industry relying on the utilization of space resources. This was a significant evolution in the way the question of outer space was dealt with, since outer space has been regarded as *res communis*: hence outer space is the object of treaties for which Parties are not private entities, but States. This situation still made room for private interests, but left the issue of ownership, for the most part, open.

As a result, the current debate surrounding the utilization by private entities of space resources has been focused on the question of appropriation. At the national level, States in favor of space mining begin to adopt national legislation unambiguously recognizing property rights over extracted resources to help support the development of this new industry; in the meantime, the international community continues to discuss whether the non-appropriation principle enshrined in Article II of the Outer Space Treaty extends to resources contained in celestial bodies.

Yet, when putting the situation in perspective, it appears that the question of the appropriation of resources is not determining. Existing legal models and practice show that the utilization of natural resources is not contradictory with outer space being *res communis*, nor is their exploitation by private entities. The adoption of the High Seas and Deep Seabed regimes in particular, are clear illustrations of this point.

The exploitation of space resources by private entities also raised the issue of regulating this new activity. On the one hand, States are in better position to regulate activities carried out by their nationals; on the other hand, international areas are better governed at the international level. Both have their advantages and inconveniences. A national

approach would be more adapted to answer the specific needs of space operators but limited to the State's jurisdiction; and an international approach will take time, probably more time than is needed to develop the technology for space mining, potentially leaving a dangerous gap where an industry could develop mostly unregulated. In this context, Luxembourg's proposal to articulate an international regime that leaves to States enough leeway to respond to the particular needs of space actors should particularly be appreciated as a way to combine those two necessary approaches.

A parallel can be drawn with the High Seas and Deep Seabed regimes. While, as demonstrated in this thesis, these regimes cannot be directly transposed to outer space, they provide legitimate solutions to balance the commercial exploitation of natural resources with the protection of the environment exploited. For instance, the High Seas regime outlines a series of measures to protect the marine environment from unsustainable exploitation and pollution, and leaves to States the role of supervisor; the Deep Seabed regime shows the benefits of centralizing at the international information regarding activities undertaken by States.

Therefore, the future international regime should recognize the possibility for States and their nationals to appropriate space resources and lay down general measures, particularly relating to the environmental protection of outer space. In this framework, the authorization and supervision of space mining missions and the development of concrete environmental measures would be left to States.

Lastly, the future legal framework should acknowledge the special status of the Moon as Earth's unique natural satellite and restrict its exploitation to scientific investigation, leaving commercial activities limited to outer space.

Reflecting on the future legal framework of outer space is not an exercise, valuable as it is, in theory. It corresponds to crucial interests of mankind, as resources found in outer space can be regarded as a substitute for resources extracted from Earth at a time when such resources are becoming scarcer. That private entities can be the ones carrying out the mission to use outer space is probably less important than protecting mankind from the negative outcomes this exploitation can lead to. This is why it is important not to repeat what has been done on Earth: exploit first, be concerned about consequences only second. It is the role of legal reflection to provide the elements of consideration that will help find a solution to such dilemmas.

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